

**ASSESSING THE EFFECTS OF STONE QUARRYING: THE CASE OF WENCHI  
MUNICIPALITY IN THE BRONG AHAFO REGION OF GHANA**

**By**

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## DECLARATION

This thesis has not been previously submitted for any degree in any higher institutions of learning, to the best of my knowledge. This thesis contains no material previously published or submitted for publication by another person except where due reference has been made.

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## **ABSTRACT**

The geological formation that underlain the Wenchi Municipality has attracted a number of quarrying companies into the Municipality to the extent that the industry has gradually gained prominence and serve as a source of employment and revenue for the Communities, Traditional Council and Wenchi Municipal Assembly (Wenchi Municipal Assembly, 2006). However, there have been several concerns raised by many people especially the host communities who are farmers and depend mainly on agriculture for their livelihood, with regards to land degradation, pollution and deforestation resulting from the operations of quarry companies. This study was therefore undertaken to examine the operational methods used in quarrying activities by quarry companies, assess critically the economic, environmental and social effects of the quarrying activities, identify and assess existing mitigating measures by quarry companies in the Wenchi Municipality, and provide policy recommendations on sustainable stone quarrying in the Wenchi Municipality. This research adopted the Case Study Approach and employed purposive and simple random sampling techniques to elicit relevant information for this research. In all this research, we directly interviewed 140 respondents including institutions (Household heads (90), the Environmental Protection Agency (3), the Traditional Authorities (9), Wenchi Municipal Assembly (8), Key Informants (24) and the Quarry Companies (6)) through the use of semi-structured questionnaires and interview guides to supplement secondary data from literature. It was revealed from this research that, all the quarrying companies in the Municipality use the open cast method of quarry extraction with both simple and sophisticated equipments. The effects identify were among others the destruction of habitat, destruction of the environment, social corporate responsibility, cracks in buildings, payments of taxes and royalties, employment creation and wages generation. Following the potentially negative environmental effects of quarrying, a number of extenuation measures including warning signals, watering trucks, timing restriction of activities and environmental awareness and sensitization programmes among others are being implemented to decrease the adverse impact of quarrying. This research recommended that stakeholders in the quarrying industry be made aware of the negative environmental effects associated with quarrying to enable the adoption of best practices to enhance environmental sustainability.

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## **CHAPTER ONE**

### **GENERAL INTRODUCTION**

#### **1.1 Background to the research**

The idea of sustainable development or sustainability signifies an effort to link environmental goals to economic development. This was successfully achieved by means of the report “Our Common Future” by the World Commission on Environment and Development also known as the Brundtland Report. The report was explicit that life-threatening worldwide environmental issues were equally the consequence of the great penury of the south as well as the unsustainable patterns of consumption and production in the north (Kendie & Martens, 2008).

According to Robison (2004), the massive and composite issues of the declining of the environment ought to be incorporated with the problems of human development and penury which are correspondingly massive and composite. This he argued, offers a clear suggestion that the two had to be fixed concurrently and in a manner that is reciprocally reinforcing.

The West Africa region has been the target of mining and other extractive activities for over thousand years. According to Agbesinyale, Tenkorang and Dankwa (2012), the region experienced the gold rush process in the course of the 90’s when member countries were advised by International Financial Institutions (IFIs) to engage in comprehensive economic reform and open up their investment markets to attract more foreign direct investment. Ever since, West African countries are dependent on mineral resource extraction to propel economic development.

Quarrying comprises finding quarry resources, typically rocks, located on or beneath the earth crust. The disparity that exists between mining and quarrying is that quarrying takes out rocks and aggregates that do not contain metal while mining exhumes the site for metallic mineral deposits (Banez, Ajaon, Bilolo and Dailyn, 2010). Sandstone, limestone, perlite, marble, ironstone, slate, granite, rock salt and phosphate rock include some of the stones often extracted.

Quarrying is one such mining activity which comes with both positive and negative effects on its immediate surroundings. These include environmental, health, social and economic effects. The negative environmental effects associated with quarrying includes: noise and vibration, dust

pollution, destruction of the environment and cracks to buildings. Stone deposit is significant natural resource that can stimulate development in a locality as well as the countries in which they are found. The extractive industries contribute immensely to the economic development of the country. However, their operations may result in some adverse effects with regards to the usage of land as well as environmental problems that may need to be addressed so as to ensure sustainable development.

While quarrying comes with substantial social and economic benefits to neighbouring communities, significant effects of the environment, more expensive cost of food and shelter, and social effects from the increased inflow of immigrants, pressure on health and public services, prostitution, gambling, and alcohol consumption are also common problems associated with mining communities (World Bank, 2003). Quarrying products are progressively demanded in large quantities for industrial, domestic, agricultural and other uses to be able to meet the desires of the increasing populace. Generally, processes of quarrying engross the elimination of overburden, drilling, blasting and crushing of rock materials and haulage. These operations come with their various effects which sizes as well as locations are equally reliant on. Appearances of particular impacts are on the air, water, soil, earth surface, flora and fauna, and human beings (Areola, 1991; Enger & Smith, 2002).

Given this background, there is the need to assess the effects of the continuous exploitation of non-renewable resources on local communities in order to provide best practice options to mitigate the adverse effects and sustain the benefits to societies by ensuring environmental sustainable practices.

Notwithstanding the negative effects of quarrying, some of the quarrying companies leave behind positive legacies in their operational areas through the fulfilment of their corporate social responsibilities. For instance, a study conducted in the remote Kahama District of Tanzania reveals that in 2001 Barrick invested US\$2 million on a long-tenure educational program in the Kahama District, which at that time was the most abysmally performing zones. As at 2007, primary school registration had shot up by seventy-five percent (seven thousand children) and by 2011, registration in high school had increased by over twice the usual number (from around eight hundred students in 2001 to 1,885 in 2011). Over eighty-nine percent of students who

finished secondary school excelled in their final exams - up from just sixteen percent before the execution of the programme (Commission for Africa, 2005).

## **1.2 Problem Statement**

Quarrying industries have gradually gained prominence over the last years and serve as a major source of revenue for the Wenchi Municipal Assembly (Wenchi Municipal Assembly, 2006). However, there have been several concerns raised by many people with regards to land degradation, pollution and deforestation resulting from the operations of quarries. Besides the introduction of new companies and the issuing of more permits to operators into the mining sector by the regulators, the rate of land degradation, pollution as well as the neglect of the interest of the communities have been on the increase resulting in dislike for the activities of quarrying industries by the local communities (Minerals Commission, 2001).

Local communities are affected by dust from the source and deposited dust with particles settling on clean or polished surfaces. The impacts of stone quarrying processes on the people's healthiness are significant since vibrations have produced crevices in some housing imperiling the lives of the residents. Additional possible impacts of quarrying that are greatly considered by environmentalists comprise biodiversity loss, land degradation and decreased plant growth (Wenchi Municipal Assembly, 2006). With the majority of the communities in the Municipality depending solely on agriculture specifically crop farming as their main source of livelihood, the loss of biodiversity and land degradation will invariably have an impact on total crop yields. Farmers will therefore have little to sell thereby affecting their ability to raise money to meet their basic needs.

Importantly, Baird (1992) has noted that solid dust particles suspending in the air and are typically unseen by the physical eyes of individuals have implications for good health. As observed by Montgomery (1992), the particles consist of soot, smoke, ash from fuel (primarily coal) combustion, dust produced in the course of industrial activities of the raw material into sizeable aggregates for the market.

In the face of the foregoing, this study seeks to examine the effects the quarrying activities have on the inhabitants of the Wenchi Municipality of Ghana. The Assessment of the effects

encompasses the areas of environment, health, social and economic dimensions. This study therefore attempts to assess the extent to which quarrying activities affect the host communities and the best ways to mitigate the adverse effects while simultaneously enhancing the enabling effects.

### **1.3 Research Questions**

Broadly this study seeks to find answer to the question: what are the effects (negative and positive) of quarrying on the social, economic and environmental development of the Wenchi Municipality? Answers are sought for the following specific research questions:

- What methods are employed in quarrying activities in the Municipality?
- What are the effects of these activities on the environment, health and socio economic development on the communities?
- What are the mitigating measures put in place by quarrying companies to avert the adverse effects of quarrying?
- How effective are the existing mitigating measures?

### **1.4 Research Objectives**

Generally, this study examines the effects of quarrying on the development of the Wenchi Municipality. The specific research objectives include, to:

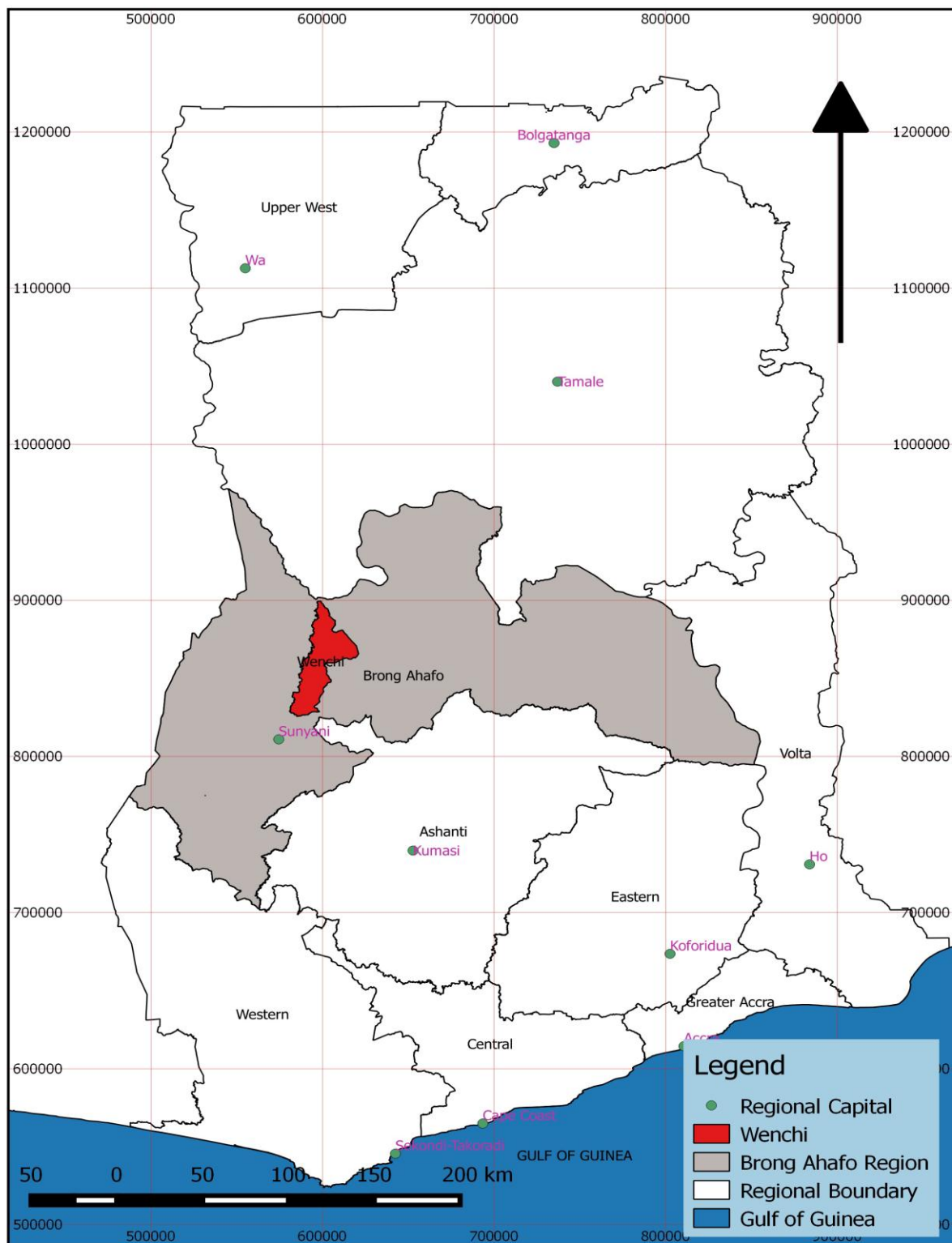
- ✚ examine the operational methods used in quarrying activities by quarry companies;
- ✚ assess critically the economic, environmental and social effects of the quarrying activities on the Municipality;
- ✚ identify and assess existing mitigating measures by quarry companies in the Wenchi Municipality; and
- ✚ Provide policy recommendations on sustainable stone quarrying in the Wenchi Municipality.

### **1.5 Scope of this research**

Geographically, this research is restricted to the Wenchi Municipality in the Brong Ahafo Region. The Municipality lies between latitudes 7° 30 and 8° 05 North and longitudes 2° 15 West and 1° 55 East. It is bordered to the North by Kintampo South and Banda Districts, to the

South by Sunyani and Techiman Municipalities a, to the East by Techiman North District and to the West by Tain District (See Figure 1). The 2010 Population Housing Census (PHC) puts the population of the municipality at 89,739 with females forming 50.90 percent.

Contextually, this research explores how quarrying activities are conducted, to determine the environmental and societal effects of quarrying on the host communities. Existing mitigating measures of the quarrying are also evaluated. Figure 1 depicts the Wenchi Municipality in the context of the Brong Ahafo Region as well as Ghana.



**Figure 1: Wenchi Municipality within the Regional and National context**

Source: Wenchi Municipal Assembly, 2010.



## **1.6 Significance of the Research**

As indicated in the introduction, sustainable development depends largely on the stability between social and economic and environmental effects on the different categories of human activities. Therefore appreciating the effects of human activities and taking measures to mitigate the negative effects is a prerequisite for poverty reduction and stimulating development among affected folks. The exploitation of minerals in the Wenchi Municipality has been on-going for nearly 3 decades. There is the need to investigate and to appreciate the possible effects of continuous quarrying on the social and economic development of the Municipality. This research serves as an avenue to institute mitigating measures to foster harmony between the environment and development.

Furthermore, the findings from this research are relevant to existing knowledge in the area of study. This will help in understanding and appreciating the nexus between quarrying, social and economic development and the natural environment. In addition, this research provides a platform or basis for further research by district assemblies, research institutions or individuals into the above stated area thereby bridging the gap between theory and practice. This also help to test the validity of findings and the efficacy of recommendations adopted and implemented from this study thereby contributing to the body of knowledge and extending the frontiers of knowledge in the area of decentralization and service delivery.

## **1.7 Organization of Chapters**

This research is structured into five chapters. Chapter One focused on the background, problem statement, research questions, objectives, scope and justification of this research.

Chapter Two is used to review relevant literature pertaining to mineral extraction and social and economic development. This chapter gives the conceptual framework of the research and the basis for in-depth analysis in chapter four. The third chapter focuses on community profile and research approach and methodology. It describes the research design, sampling techniques and data sources, collection techniques, processing, analysis and presentation devices that were employed to carry out this research. The fourth chapter analyzes, processes and presents the primary and secondary data collected from the field.

Finally, chapter five elucidate, the major findings of study in relation to the stated objectives. Recommendations are also made as policy prescriptions for minimizing the adverse effects and maximizing benefits of quarrying activities on the environment and communities. The chapter also ends with a conclusion to the entire research study.

## **CHAPTER TWO**

### **LITERATURE REVIEW ON THE EFFECTS OF STONE QUARRY IN THE WENCHI MUNICIPALITY**

#### **2.1 Introduction**

This chapter constitutes a review of the literature connected to the effects of stone quarrying in the Wenchic Municipality. Areas covered include definition and nature of quarry and quarrying, methods and tools for quarrying, environmental and social and economic effects of quarries. The chapter also touches on sustainable development and its linkage to the environment and ends with some extenuation measures and approaches for quarrying process.

#### **2.2 Definition of Stone Quarrying**

Generally, stone quarrying is a multiple stage procedure through which rock is dug from the earth and crushed to generate aggregate that subsequently is divided into portions necessary for direct use, or for more processing, such as coating with bitumen to make bituminous macadam ([www.northstonematerial.com](http://www.northstonematerial.com), 11<sup>th</sup> August, 2014). A quarry is a site where dimension stone, rock, construction aggregate, riprap, sand, gravel, or slate has been dug from the earth. A quarry could also refer to an open-pit mine from which minerals are unearth. According to Akabzaa & Darimani (2001) quarrying is an open pit out of which any beneficial stone is extracted for usage in the fields of building and engineering.

Mining, on the other hand, is the unearthing of valued minerals or additional geological elements out of the ground, normally from an ore body, vein or (coal) seam. Elements obtained through mining constitute base metals, valuable metals, iron, uranium, coal, diamond, limestone, oil shell, rock salt and potash. Any element which is impossible to generate by means of agrarian procedures or produced unnaturally in a laboratory or industrial unit, is typically mined. Mining in broader terms constitutes unearthing of any resource that is not renewable such as petroleum, natural gas, as well as water. (Akabzaa, 2004).

Songsore et al., (1994) add that quarrying of stone is an activity that has existed since primeval times. The procedures involved in the present day mining comprise of digging for ore bodies, analyzing for the turnover prospects of a suggested mine, digging out of the desired materials

and eventually, repossession of the land to make it ready for alternative purposes when the mine is shut down. Depending on the method used in stone quarrying there will be little or a high potential negative effect on the environment as well as lives around the quarry site. As a measure to mitigate the adverse effects of quarrying, most countries are embracing rules to restrain the adverse impact of mining activities. Security for an extended period has also been of interest although contemporary procedures have upgraded security in mines considerably. Currently, mining is capable of significantly and securely recovering minerals with minimum adverse effects on the environment (Commission for Africa, 2005).

At the international level, the manufacture of natural stone and produce from natural stone has undergone a significant growth over the last ten years. A growing number of states are manufacturing natural stone. The mining and processing of hard stone kinds like marble and granite increased greatly as a result of novel methods of manufacturing. While production in traditional European stone manufacturing countries like Italy, Spain and Portugal is declining, China, India, Turkey, Brazil as well as other countries that are developing and recently industrialized are continuously increasing the manufacture of natural stone. In relation to number, China currently mines double the natural stone of Italy, the leaders of the market of Europe (Weyzig, 2006).

Weyzig (2006) further states that several persons as well as municipalities regard quarries to be a blot on the landscape and several reduction procedures to tackle complications with noise, dust and appearances. Among the most efficacious and well-known instances of fruitful quarry restoration has been Butchart Gardens in Vitoria, BC, Canada.

### **2.2.1 Methods of Operation (Modus Operandi)**

Quarrying is done using differing procedures and instruments like hand tools, explosives, or power saws, and by channeling and wedging, in accordance with the objective which necessitated the extraction of the stone (Campbell, 2004). Basically all stone quarrying activities carried out worldwide either combine or use one of the following basic tenets:

1. **Levering:** increasing open fractures by injecting levers, crowbars or stones.

2. **Splitting:** making fractures, preferable planar, by strokes (i.e. sledge hammer), wedging, heating or blowing up with explosive devices.
3. **Channeling (carving):** creating conduits in the rock by engraving with hammer and chisel, pickaxe or stone tools, heating with fire, sawing or drilling.

Levering is seen as the “simplest” way of extraction which comprises increasing the size of regular fractures or additional levels of weakness (such as bedding planes) using several implements. Splitting is the procedure of creating fresh cracks for removing rock. This could be accomplished through percussion (stroke), injecting wedges of some kind in prefabricated holes or through heat. In a contemporary setting, splitting is achieved by setting off explosive devices in holes that are drilled. Though splitting methods could be used on the vast majority of the kinds of rocks, its function is finest on hard siliceous (quartz rich) ones. Partially as a result of the fact that they generally exhibit the most delicate characteristics, but also as a result of it being a properly recorded detail (and experience among quarrymen) that siliceous rocks (granite in particular) are characterized by properly demarcated preferred splitting directions defined by micro fractures in quartz ([www.quarryscapes.no/text/publications/factsheet5.pdf](http://www.quarryscapes.no/text/publications/factsheet5.pdf), Accessed on 11<sup>th</sup> May, 2013).

Channeling is the third primary technique. Channels in the rock are created by eliminating the rock mass through chiseling, picking, sawing or heating. In majority of soft stone quarries from the Bronze Age onwards, channeling is the extraction technique of greatest import. In majority of the cases, channeling is merged with alternative techniques. For example, channels are created vertical to the original stratum of the rocks. Once the block has allowance on four sides, it is divided with wedges (“trench and wedge” method) or levers/crowbars placed in chiseled trenches (“Minoan technique”) or by placing wooden wedges in the channels proper, making shear stress along the block’s bases ([www.quarryscapes.no/text/publications/factsheet5](http://www.quarryscapes.no/text/publications/factsheet5.pdf), Accessed on 11th May, 2013).

Blasting could as well take place every day or as less frequently as one or two times annually. The blasting methods employed in crushed stone processes are expressly variant to the ones employed in dimension stone quarrying. While huge quantities of explosive devices are employed in crushed stone activities to generate rubble of the appropriate size, the dimension

stone business employs just a little number of explosive devices to only small amounts of explosives to unloose huge slabs of stone (Langer, 2001). Generally, explosive devices are used to unfasten huge slabs of stone, which are subsequently divided and cracked into rubble or fragments through the use of wedges or through the use of the plug-and-feathers method, or crushed by a hefty steel ball weighing numerous tons. With this technique of quarrying, the drill holes are put down to the depth to which it is necessary to crush the rock and are then partially packed with some explosives that are detonated by the normal technique (Redmond, 2005). Table 2.1 shows the principles of extraction and associated processes or features in relation to stone quarry.

**Table 2.1: Principles of Extraction and Associated Process/Features**

<b>Principle</b>	<b>Process</b>	<b>Tools</b>	<b>Tool marks</b>
<b>Levering/extraction on fractures</b>	Crack expansion	Logs Crowbars Stones	Hardly any
<b>Splitting</b>	Percussion	Stone hammers/pounders Chisel Pick Sledge hammer	Percussion marks, plumose marks on cracks
	Wedging	Simple iron wedges Plugs and feather wedges Wooden wedges	Wedge marks of various shapes
	Heating	Fire	Surface parallel flaking
	Blasting (M)	Explosives	---
<b>Channelling</b>	Carving	Chisel Pick Stone tools	Straight parallel Curved parallel Pointed grooves
	Sawing	Blade Wire	Sawn surface, straight grooves Sawn surface, curved grooves
	Drilling (mainly modern)	----	----
	Heating (mainly modern)	Fire	---

Source: [www.quarryscapes/factsheet5](http://www.quarryscapes/factsheet5), (Accessed on 11<sup>th</sup> August, 2014)

### **2.3 Effects of Stone Quarrying Activities**

Produce from quarrying are progressively required for industrial, domestic, agrarian and further uses in order to gratify the requirements of the quickly increasing populace. Procedures involved in quarrying commonly comprise the elimination of over burden, drilling, blasting and crushing of rock materials. The magnitudes of the effects emerging from these activities are equally contingent on the size and site. The appearing of particular effects are on the air, water, soil, earth surface, flora and fauna, and human beings (Areola, 1991; Enger & Smith, 2002). As well, the impact of stone quarrying could differ from environmental, economic and social facets contingent on how is being viewed. Aside land dilapidation, further adverse effects of quarrying encompass swamp formation, degeneration of ground water, erosion of soil, noise and percussions from rock blasting, creation of dust, smoke and fumes; production of noxious gases and ground vibration. Suspended particulate matter is rather outstanding amongst all pollutants generated by quarrying activities (USEPA, 2008).

Weyzig, (2006) debates that mining and penury are interconnected. Bushran (2008) for example, proved that sixty percent of mining activities take place in Indian Districts that were very 'backward' in terms of development. Hilson (2002) however writes that there is also progressive impact on people's living. Quarrying is a significant division of the economy of majority of developing countries; it creates jobs, advantages that are economically and developmentally geared in the local and national sectors. Hilson (2002) proves that for many workers who are migrants, revenue proceeding from quarrying and mining activities supplies a significant how for many migrant workers, income from quarrying and mining serves as a significant supply for their living in the periods of the year when agrarian and livestock activities generates small profit.

It is obvious that stone quarrying as any human activity impacts the physical environment, economy and the social life environment within which it operates. It is also the case that this impact could be either advantageous or adverse in nature and this is contingent on the way it is managed.

### **2.3.1 Environmental effects of stone quarrying**

The greatest combative environmental effect natives residing beside quarries and surface mines suffer are those generated by blasting (Langer, 2001). This is not only by word of mouth but has been proven by surveys conducted by various authoritative people and institutions. Nartey et al., (2012) did a study on the impact of quarry operations on particular communities in the Lower Manya Krobo District of the Eastern Region of Ghana and they noted that, several buildings had developed different degrees of fractures with some on the bridge of collapsing. These fractures primarily were as a result of heavy vibrations generated from rock blasting. They also indicate that farmlands have been destroyed in the deluge of waters pumped from the quarry pits as well as run-offs. The Food and Agriculture Organization's (FAO) assessment (1996/97) indicated that a greater percentage of Ghana's vegetation cover is affected by human activities such as bushfires, quarrying and lumbering. Hawthorne (1990) estimates that, about 35 percent of agricultural land which are fertile for both food and cash crops cultivation have been taken over by the extractive industry.

Weyzig (2006) in a study on quarrying in India revealed that, the careless discard of solid waste by quarries in India and processing plants is a situation that occurs regularly, and causes great harm to agrarian zones. He further observes that state laws and regulations on the environment are flouted and quarrying results in the devastation of habitations. The necessary re-establishment, recovery and restoration of mines, as necessitated by the laws of India, are usually ignored or averted.

Other writers have also stressed on the environmental effects of the emissions from processes of quarrying which come with it health hazards and complications. According to UNEP (1991b) solid materials in the form of smoke, dust and vapor produced in the course of quarrying operations are typically up in the air for a protracted time. More so, it is possible to convey particulate matters in the air from the point of where they were produced to zones far from that place. When particles of various chemical structures are breathed in, they are deposited in the lungs of humans thus instigating lung deterioration and breathing problems (Last, 1998). To Deborah (1996) and the National Industrial Sand Association (1997), dust produced through the quarrying of granite includes a silica percentage of seventy-one. Breathing in dust of this sort



causes silicosis which can disable a person who is exposed to it and could eventually cause death.

In terms of waste disposal, it is believed that, the quarrying sector generally, and the stone businesses particularly have not as yet learnt how to handle air, water and noise contamination. Quarry waste comprises overburden as well as production waste. There is a significant quantity of waste produced by clipping the edges of the slabs. Fragments, uneven and abnormally formed blocks are dispersed in the quarrying sites and processing units. Madhavan & Raj (2005) observed for instance that in most countries the quarrying waste on lands which have not been legally acquired and without permission often leading to the destruction of the natural vegetation and ecology of the site.

Quarrying also has the potential of generating noise and air pollution through related activities like drilling, screening, blasting, sand conveyance, sandstone production and open-cast quarrying. According to the Department of the Environment, Heritage and Local Government (2004) depletion of top soil and overburden, exhumation through the use of machines, drilling and blasting of rock, crushing and screening of aggregates, conveyance of raw materials and completed products within the location and on community roads are all noise generating activities and nuisance to the environment. They further argue that blasting can generate vibrations, perceptible noise, fly rock and dust which is disastrous to lives within the environment of quarrying. The noise from traffic from vehicles, counting vehicles that are off the road, has the prospect of disturbing wild life, at times inhibiting the usual procedure of reproduction. Though certain wild life could probably become used to the blasting noises, others would migrate from the site, possibly decreasing the population of that genus.

Finally, Quarrying can significantly transform the routing of recharge and water value could be ruined (Gunn & Hobbs, 1999). Generally, the primal effect of quarrying is to eliminate the overlying vegetation and soil. Within temperate zones, eliminating vegetation and soil decreases evapotranspiration and causes an upsurge in the effective rainfall. Except steps are implemented to regulate runoff and sedimentation, degeneration of ground water is probable.

The discussions so far point to the fact that the effects stone quarrying are not independent from the environment it operates from. The activity exerts numerous adverse effects on the environment which may need consideration for extenuation in order to reduce its adverse effects to the barest minimum.

### **2.3.2 Social and Economic Effects of Stone Quarrying**

Quarrying activities tend to have several effects on both the economic and social lives of the workers as well as the people in the host communities. It can affect persons who are not directly involved in it. It is in light of this that this sub-section seeks examine the various scenarios under which stone quarrying affects the lives of the people in the host communities.

#### Employment

Quarrying operations create jobs and contribute to a country's gross national product, by means of making produce for local use and exportation. The increasing demand for quarrying goods helps to improve upon the employment situation in quarrying areas. A good example in this respect is found in Rajasthan, the pivot of the sandstone business in India. Per Finnish research, the sandstone mines of the state give jobs to almost two million individuals, and above hundred thousand individuals in the city of Jodhpur only. In Western Rajasthan, the sandstone business is the biggest industrial sector, with regards to the number of people involved in the trade (Finnish Institute of Occupational Health, 2002).

Also Weyzig (2006) added that Rajasthan being the focus of India's marble industry is responsible for ninety-five percent of the state's marble production. In Rajasthan's Nagaur district, a space of about hundred square kilometres, about twelve thousand to fifteen thousand individuals have a job in marble quarrying. Nagaur is one of the districts of Rajasthan that is chief in the production marble.

Auty (1995) states that the pronounced adverse effects of quarrying on society, notwithstanding, quarries can make immense contributions to the social and economic development of the localities within which they operate. He came out with the following as services that can be

provided for the communities by quarry firms through corporate social responsibility arrangements:

- Provision of jobs for the community,
- Increase in commercial activities,
- Increase in the level of revenue generation of the community dwellers,
- Providing of social amenities such as schools, health facilities, roads and community centres.

Auty's (1995) idea is very true to the extent that notwithstanding the adverse effects of quarrying, the activity also provides employment opportunities for the community members. Men and women get involve in quarrying for a living. Men mostly work the mines and the women work on crushers. In short-distance transportation, women generally carry head loads of baskets from the mine site to the crusher site.

It can be inferred that one of the outstanding effects of quarrying is the provision of both direct and indirect employment for the people around the area of operation. The activity also breeds ancillary ventures such as food vending often involving the local population and in effect raising their standard of living.

#### Loss of Agricultural land

Quarrying mostly occurs in rural communities where a huge number of the populace is dependent on agriculture for a living. Continuous quarrying can reduce farm land as the activity involved in quarrying turns cultivable lands into uncultivable. This was raised by Adams (2001), when he argued that quarrying is one of the occupations that have serious degrading effects on land. When out of control, it defeats the objectives of land management.

In most cases the quarry sites are given to the operators by government regulatory agencies or local authorities without holding ample consultations with the communities (Candessus, 2001). Over here, consideration is not given to the livelihood of the rural folks in that, about 80% of them depend on agriculture and for that matter depend on the land for their survival. The only relief for the rural folks may be the compensation that is paid to them based on the crops they

lose to the quarry operation, but the question is for how long they can survive with the compensation given as compared to their cultivable land that has been degraded. Compensation is mostly woefully inadequate and rather worsens the plights of those who are the unfortunate victims or whose land is taken over by the quarry firms (Delbridge & Lowe, 1998).

A forestry department inventory between 1986 and 88 indicated that close to 20 percent of these extractive sites affect a number of protected areas. About 26 percent of these protected areas are under serious threat (Candessus, 2001).

#### Effects on Social Lifestyle

Quarrying impacts the social life of the group of people who are engaged directly or indirectly in the activity. Women and children with no better prospects get involved in the quarrying activity for a living using basic tools like shovel, hammer, sieve, bare hands, wicker basket, and intermittently stone crushers. Reports released by Indian Non Governmental Organisations show that distressing circumstances for kids and grownups residing and employed in mining sites within India. The indigenous population and women are the main victims amongst these. The report India's Childhood in the "Pits" published by HAQ, SAMATA and Mines, Minerals and People (MM&P) (2003) reveals that districts which are totally reliant on mining have a lesser number of literates as compared to the national average. The death rate of children below five years old is greater.

#### Child Labour

Child labour is mostly profound in quarrying centre's. It is quite common to find children of school going age heavily engaged in stone quarrying in order to earn money for their families. Children born in the isolated mining zones straightaway begin with a huge demerit. Since amenities for child care are unavailable and schools usually are non-existent in the location, women who have children usually are pressed to carry their children along with them to the quarry. At an early age, they learn how to crush the stones into little blocks or assist with filling the trucks with the stones.

The International Labour Organisation approximates that over a million children worldwide are engaged in mining. Nonetheless, an organization situated in Rajasthan, India, approximates that

in that state only, three hundred and seventy-five thousand children work in the mines and quarries throughout that state. In the state of Karnataka a minimum of 200,000 children are estimated to be working in quarries in India. Cheap child labour is welcome by the contractors.

#### **2.4 Legal and Regulatory Framework of Mining in Ghana**

The Minerals and Mining Act 2006, (Act 703) assign resolutions and the usage of mineral plots in Ghana to the Head of State to regulate it for the development of the state. The case by which the extractive industries do capitalize on the laxity of the regulations, pervasiveness of penury and the illiteracy of the native people in sites of mineral withdrawal to take unjustified advantage of the typically little capability of developing countries to mine in unsustainable manner thereby living the indigenes in an abject poverty, this becomes a recipe for conflicts in many mining centres. The relatively abject Poverty in mineral endowed centres could be attributed to weak legislature that exists in developing countries.

The main institution charged with the regulation of mining in Ghana is the Minerals Commission, a government outfit instituted established under Article 269 of the 1992 Constitution and the Minerals Commission Act, 1993 (Act 450). The Minerals Commission as the controlling organization for the Ghanaian minerals industry is charged with the responsibility of regulating and managing the exploitation of the mineral wealth available within the country. It is also responsible for organizing and executing policies which pertain to mining. It also makes sure there is submission to the Mining and Mineral Laws and Regulations of Ghana through observing. The commission is again responsible for granting mineral permits to prospective mineral exploiters. The Environmental Protection Agency is also another institution mandated by the Government to issue environmental permits to the quarrying companies and to also ensure that they comply with the necessary environmental guidelines governing the exploitation of minerals in a more sustainable manner. The companies are mandated by law to submit Environmental Impact Assessment (EIA) reports to the Environmental Protection Agency (EPA), stating the potentially negative effects of their operations on the environment and mapping out strategies for mitigating the stated effects.

The laws regulating mining in developing countries are weak and so add to the externalization of environmental cost of mining and so assist firms perceive the feeble environmental regime and the feeble capability of societies which have been sidelined in order to secure their rights as making provision for the conducive environment for expatriate investors in the extractive industry. The demand for modifications within the mining and mineral laws of Ghana by mining societies, mining support firms and civil society in general is as a result of the fact that the prevailing mining regulations had been unsuccessful in meeting the purposes already mentioned. Nevertheless, the mining lobby as well is demanding for a reformation of mining law with the aim of providing Ghana with a competitive advantage in the drawing of Foreign Direct Investment in Africa (Akabzaa & Darimani, 2001). The consequence of the aims of the requirements of the mining lobby is the increased lessening of values associated with the mining laws. From 1994, over seventy states in the south have amended their laws to draw expatriate gold mining firms. The Ghanaian government has made attempts to reform Ghanaian mining laws and a new mining bill that was placed before Parliament was withdrawn as a result of vilifications from NGOs, communities and civil society. The motive they provided was that ample discussion together with effort there had not been adequate consultation with and effectual contribution of mining communities and additional stakeholders in the deliberations on the new mining bill was absent (Owusu-Koranteng, 2005). A part of the new mining bill which is of interest is the presentation of a Stability Agreement, which certifies that the motivations and security that former laws and arrangements gave multinational mining corporations in the law are guaranteed for fifteen years.

Actually, the mining lobby demands a Stability Agreement for thirty years, which suggests that in the time of the Stability Agreement, it would not be likely to change any of the lavish motivations given under the law to the mining corporations even if they are inimical to the national interest (Akabzaa & Darimani, 2001). Likewise, the Development Agreement, that focuses a substantial level of power in the Minister accountable for mining on concerns such as conflicts, has been vilified as a way through which the mining lobby can affect conclusions and additionally erode community rights (Centre for Democracy and Development (CDD), 2005). When it boils down to the actual advantages of mining investments on the basis of law, certain

mining corporations have bargained consensus for the maintenance of eighty percent of the sale of gold offshore.

## **2.5 Sustainable Development**

The World Commission on Environment and development's (the Brundtland Commission) Report, christened "Our Common future" (1987) slated a landmark definition for Sustainable Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The proponents of sustainable development propose that supplying the demands the future is contingent on how properly we are able to ensure social, economic and environmental aims or needs are in equilibrium when making choices currently. All explanations of sustainable development demand that we view the world as a system – one that connects space and time.

Sustainable Development has become a global concern with the main motive of meeting people's needs and preserving natural resources. To achieve these, International Conferences like "The Earth Summit" convened in Rio de Janeiro in 1992, the conference on "Sustainable Development" in Johannesburg were held to canvass efforts towards sustainable global development. During these meetings it became generally acknowledged that development and the biophysical environment (in its broadest sense) could not be separated and that one was dependent and correlated to the other one. The Rio+20 conference of world leaders confirmed their dedication to maintainable development which encompasses economic advancement, social advancement as well as environmental safeguard for the profit of everyone. One of the primal results was the appeal to create a set of generally implementable sustainable development goals (SDGs) that judiciously put in equilibrium the environmental, social and economic aspects of sustainable development. The crux of sustainable development is to create a way by means of which economic development can advance, while concurrently improving human development and making sure the of the long tenure feasibility of the natural systems which development relies on.

The concept was further extended by Dreschler (2001), who saw the concept of Sustainable Development as a result of increased awareness of how finite resources such as minerals will be

preserved to support future livelihoods. With respect to small scale mining, emphasis is placed on other activities which will sustain a community long after the minerals were depleted. The method used in exploiting the mineral resources is as important as achieving sustainable development, as a relatively an unsustainable method of exploiting mineral resources can exert enormous offensive effects on the environment as well as life at some point in the future. This will defeat the cardinal principle of sustainability as the current generation may enjoy the benefits of resource utilization whereas the unborn generation may bear the consequence of the bad mining methods used, that may prove expensive to them.

For instance, Madhavan & Raj (2005) argue that agrarian activities are no more a maintainable employment for Budhpura farmers. They are unable to get a decent yield even during periods when the fall of rain is above average. The deposits of quarry dust which fall on the leaves retard the development and blooming of crops. The quantity of water in wells and ponds within the site has fallen dramatically as a result of quarry pits surrounding the village recurrently becoming deeper. The careless discarding of quarry waste is worsening this condition.

### 2.5.1 Principles of sustainability

- ✚ **Human-ecological systems integrity:** Build human-ecological ties to sustain the reliability of biophysical systems so as to sustain the non-replaceable life sustenance functions on which the welfare of humans is reliant.
- ✚ **Sufficiency and opportunity:** Make sure that all persons have sufficient resources for a good and reasonable livelihood and that all persons have the chance to pursue advancement by means that do not diminish the prospects of progeny for sufficiency and chances.
- ✚ **Equity:** Make sure that sufficiency and effectual options for all persons are choices for all are carried out through means which decrease the perilous breaches between sufficiency and chances (and healthiness, safety, social acknowledgement, political control, etc.) between the affluent and the indigent.
- ✚ **Efficiency and throughput reduction:** Supplies a bigger basis for making sure of maintainable means of support for everyone. This decreases the risks to the long tenure



reliability of social and economic systems through the avoidance of waste as well as decreasing the total material and energy use per unit of profit.

- ✚ **Democracy and Civility:** Building our capability to make use of maintainability principles by means of a well informed and unified array of administrative, market, customary and personal decision-making practices.
- ✚ **Precaution:** Have deference for indecision, avert possible dangers of grave or non-reversible impairment to the bases of maintainability even if not properly understood, strategize for surprise and manage for adaptation.
- ✚ **Immediate and long-term integration:** Operate all tenets of maintainability at once, searching for reciprocally supportive profits.

### 2.5.2 The linkage between Environment and Sustainable Development

According to the European Union (1989) the environment is defined as the amalgamation of components whose composite interconnection constitutes the location environs and circumstances of the life of the person and of the community as they are felt. It is the environment which gives the circumstances for advancement and growth including peril and injury. The environment encompasses natural resources (fauna, flora, water, soil and minerals) and ecosystem services (crop production, energy supply and soil maintenance). These resources and services are being destroyed primarily as a result of upsurges in the populace as well as consumption. The environment can be examined from two viewpoints, thus the human and natural environment. The natural environment includes all animate and inanimate things taking place naturally on earth or in some region. It is the environment that includes the interrelations of all animate genus. The human environment on the other hand constitutes the locations and constituents of the natural environment that are strongly influenced by humans. The environment plays three core functions in lives of mankind. It serves as a basis of sustenance, as a source of development finance and as a source of environmental services underpinning social and economic development. The exploitation of natural resources accelerates economic development but in order to achieve sustainability the non-renewable resources must be properly managed.

The environment-sustainable development link has been explored in Brandon & Brandon (1992), Ghai (1994) and Taylor (1996). According to these authors, there is evidence of positive

feedback among poverty reduction, environmental amelioration and economic growth, but adverse effect can result from “traditional patterns” of growth. Ghai (1994) indicates that people’s interaction with the environment is influenced by access to employment and essential resources (e.g. land, credit); property systems relating to land, forests; gender relations defining women’s access to credit and other resources; and empowerment or control over resources and decision-making capacity. Thus, issues of “resources degradation and re-generation are intimately linked to questions of power, institutions, livelihood and culture” (Ghai, 1994, p.9).

Brandon & Brandon (1992) discuss the difficulty in having clear, well-defined environment-sustainable development relationship. For instance, Cheru (1992) demonstrates the trade-offs amongst short tenure growth policies and the associated environmental cost, and more sustainable development which requires a new economic policy regime. According to him, adjustment policies have increased incomes for the export sector, but increased poverty, and degraded the environment for the rural, food-growing sector.

Adelman et al., (1997, p.161) explore the association between environmental conditions and development strategies. They argued that:

*“development strategy choices influence variables which, in turn, influence environmental conditions. In particular, development strategies affect the structure of domestic production, the nature of the most binding constraints facing the environment, technological and investment choices, institutional structures, income distribution, and domestic prices relative to international prices. These variables affect energy consumption and patterns of land-use in the agricultural system, which in turn affect the extent of environmental degradation”.*

According to Potter et al, (1999) over the last century, supply of resources that are not renewable has been up to speed with needs with the continuous discovery of new resources and novel technology causing an upsurge in the effectiveness mineral withdrawal and processing. As such within the little to middle tenure, posterity is not being put in a position of disadvantage by our usage today. Within the long tenure albeit, resources that are mined without difficulty would be more difficult to locate. Thus the inescapable co-existence of development and resource utilization led to the development of the concept, Sustainable Development.

The Millennium Development Goals (MDGs) also highlight the relevance of sustainable development to humanity. Goal 7 (Ensuring Environmental Sustainability) aims to achieve sustainable development by reducing the excessive effects of human activities on the natural environment. However, UNEP (2013) revealed that looking at the 5 indicators described for this goal displays complete obedience with just the indicator which relates to decreasing the consuming of substances that deplete the ozone layer. Additional indicators demonstrate advancement that is much slower. Complete damage and loss to forests still prevails, though the rate has decreased from a yearly loss of 8.3 million hectares in the 1990 period to 5.2 million hectares in 2010. In the meantime, global production of carbon dioxide decreased between 2008 and 2009, but is increasing again. Inadequate advancement has been chalked with regard to several themes on the environment, counting biodiversity loss and dilapidation of ecosystems. Furthermore, MDG-7 has very little coverage of environmental maintainability concerns, and neglects several crucial subjects related to dry and partially dry, oceanic, mountain, grassland, and arctic ecosystems, amongst others. It does not handle the increasing difficulties of the pollution of the air and water all through majority of the third world, the building up of chemical waste, or the prevailing consuming of natural resources that is not sustainable (UNEP, 2013).

In order to achieve environmental sustainability amid increasing economic development, there should be solid connections with objectives of development. Within the SDGs, concerns pertaining to the environment ought to be connected to social and economic developmental concerns. The SDGs ought to “incorporate in a balanced way all three dimensions of sustainable development and their inter-linkages” (Rio+20 Outcome Document, 2012). Maybe, the most profitable means to link environment and social and economic advancement within the SDGs is to frame combined objectives and targets. The Rio+20 Outcome Document intimates that concerns pertaining to development should be a solid force of direction for newly created SDGs and that biodiversity and ecosystem services are crucial to sustainable development. It ensues that the maintainability of the environment within the SDGs ought to have an unequivocal connection to social and economic concerns which lead to increased welfare like the elimination of poverty. Within the same purview, personal environmental goals/targets within the SDG scope ought to be linked and consistent with each other.

It became widely accepted during the Rio+20 conferences that development and the biophysical environment were indivisible and that one was interdependently connected to the other. The cardinal idea behind Sustainable development is how to 'reconcile' environmental, economic, and social concerns. However, the concept is mostly classified as an environmental issue. The central aims of balancing sustainable development issues and the environment was that they ought to fortify as well as supplement each other by means of making sure that they deal with all of the primary goals of the environmental, social and economic aspects of sustainable development and as well, by making certain that they work together to preserve and reestablish the biological variety and ecosystem services essential to achieve social and economic goals.

In comprehensive terms, the dominant concern is the means by which to avert destruction of the environment or reduction of such destruction to the lowest but not reduce the speed of development. The environment comprises 'natural capital'; its profit and services—water flow, soil protection, and breakdown of pollutants—sustain and promote economic development. When abysmally calculated, development could contribute to the devaluation of the natural capital of a country. Even when judiciously calculated, the course of economic development inexorably brings about certain adjustment of natural ecological systems and produces wastes and pollutants.

### **2.5.3 Environment and Socio- Economic Development**

The term development has attracted many definitions, yet the central theme remains the same. It implies the social and economic upliftment of a people within a particular geographical area. Development is not economic well-being alone. In order to make development sustainable, the social and political well-being of people must become central to the development discourse. As a result of the human face now required of development programming, strategies to attain development goals are also changing. Good governance, which has the attributes of participation, equity, accountability, transparency, and responsiveness to the needs of people, is now seen as the path to sustainable development (Kendie & Martens, 2008).

Development as a process of change has been going on since the dawn of cultural history as people elsewhere sought new ways to improve on their living conditions. The process of

development became heightened during the green revolution, industrial revolution and the rise of capitalism especially from the 18<sup>th</sup> Century leading to political, social and economic transformation in the lives of many across the globe (Kendie, 2011). Development is about the politics of achieving social justice through economic change. It is the alternative ways of producing and distributing the common wealth. Development is about diverse vision and diverse solution which is intently political (Kendie, 2011).

Emphasizing on the central role of politics in development, Amuwo (2005) pointed to the fact that, the preeminence of politics as well as the nature of the state in the development discourse and practice are to attain achieve development and sustainable democracy together. Implying that, it is essential to have a politics which has the capacity to balance the varied and distinct requirements of all the differing interest groups and politics suitable for reducing and vitiating the supremacy of ruling governments, regimes, cliques, factions and individuals. Amuwo (2005) established that development primarily concerns the people, their advancement, the actualization of inherent potentials, the attainment of necessary goals, increased income, improved nutrition, availability of fundamental facilities and services which make life comfortable to live.

Currently, Dudley Seers' questions on the dimensions of development are still relevant in most developing countries. According to Seers (1969) for any country to be said to be developing, there must be change in the unemployment situation, in poverty and in distribution of income. Inference from this means that, development cannot occur if unemployment, inequality and poverty increases further or worsen.

Theorists who lived in the 1950s and 60s perceived the progression of development as a sequence of successive levels of economic growth through which all states ought to pass. It was mainly an economic postulation of development in which the right to quality and mixture of savings, investment and foreign assistance were all that was needed to empower developing countries to advance along a path of economic growth which in history had been trailed by most developed nations. This perspective to development was interchanged in the 1970s by two schools of thought.

Firstly, postulations and models of structural change apply economic theory and statistical enquiry in an effort to display the procedure of structural change that developing countries ought to go through if they are to be successful in creating and maintaining quick economic growth. Secondly, the intercontinental – dependence revolution was more extreme an political. Underdevelopment was perceived within the view of national and domestic power association, institutional and structural economic rigidities.

Once concern and attention in the poor nations of the world actually started to show after the Second World War, economists in the industrialized nations were caught unawares. They did not have any conceptual instrument promptly handy to evaluate the course of economic growth in primarily agrarian communities that did not have modern economic structure. Albeit, hey had the experience of the Marshall plan under which huge sums of US financial and technical aid empower the countries devastated by war in Europe to reconstruct and renovate their economies within a couple of years (Todaro & Smith 2009).

The viability of development depends first on the available natural resource base, and second, on the maintenance of bio-spherical balance as the earth's resources are exploited. The development experience of the industrialized countries shows that both conditions are associated with casualties. The effects of unbridled economic development have been:

- (1) greenhouse effect: a global warming caused by a combination of forest depletion and the burning of fossil fuels which is feared to (a) melt ice-caps and thus increase ocean levels causing inundation of coastal cities and valuable cropland, and (b) increased land temperatures resulting in further shortfalls of fresh water to grow crops, and in the speed of desertification;
- (2) an increasing emission of toxic wastes which pollute the quality of air, water and soils, and whose effects might be felt beyond the polluting country frontiers;
- (3) Hazards from nuclear power generation whose effects we had a glimpse of in Chernobyl in Ukraine and at Three Mile island in the US. The effects threaten the genetic heritage of posterity;

(4) holes in the ozone layer which expose man to the direct rays of the sun and increase the incidence of cancer;

(5) depletion of the earth's natural resources, especially fossil fuels, minerals and forests (Meadows et al., 1972)

These environmental causalities are qualitatively quite different from those that bedevil developing countries- which include overpopulation, food supply imbalance, lack of drinking water, sanitation problems, garbage disposal problems, liquid, solid and airborne waste- in effect, poverty.

However, the irony of the situation is that it is the industrial countries that have the technological and economic capacity for environmental remedies. Thus, even if sustainable development is defined in terms of environmental amelioration and growth, the policy implications for less developed countries remain the same – acquire the technological capacity to deal with environmental degradation.

A very worrying factor in the development-environment relationship is the over-consumption in the advanced economies and their non-cooperation in respecting international conventions Stockholm (1992), Kyoto (1997) and Johannesburg (2002). It remains to be seen whether the international financial institutions (IMF, World Bank) and the western countries will remember their commitments at the 2002 Monterrey Conference on International Finance for Development and provide the required financial support for The Millennium Development Goals, to address the issues of hunger, poverty, disease, gender equality and empowerment, primary education and environmental degradation.

## **2.6 Extenuation and Compensation Measures**

Extenuation and compensation is aimed at stopping negative effects from occurring and limiting those that happen within adequate Extenuation and compensation have a crucial part to perform in inspiring constructive development organization and in directing the development course so as to allow for improved safeguarding of environmental resources and ecosystem services.

The European Union describes extenuation in Directive 85/337/EC as processes envisioned so as to avert, decrease and if probable resolve substantial negative impacts (European union, 1985). Treweek (1999) described extenuation as any intentional act which is considered to assuage negative impacts, whether through the regulation of the origin of impacts or the exposing of receptors to them. According to Rundcrantz & Skarback (2003), extenuation is a thing which restricts or decreases the degree, extent, magnitude or length of negative impacts. European Union (2000) also defines extenuation as measures intended to minimize or even negate the adverse impacts of a project, during or after project completion. Extenuation represents both actions and inactions that help avoid and reduce project related impacts that may be linked to policies, plans and/or programmes.

It is important to draw a distinction between extenuation and compensation since compensation has to do with processes to substitute negatively affected environmental standards which ought to have like functions which are equal to prevailing values of the environment. Distinguishing compensation and extenuation, Cowell (2000) described environmental compensation as the giving of constructive environmental processes to make accurate, put in equilibrium or otherwise compensate for the damage of environmental resources. Kuiper (1997) wrote about compensation within the purview of the making of the new values, which are equivalent to the misplaced values.

If the misplaced values cannot be replaced, compensation concerns the making of values that are as alike as possible. In the United States of America, for the objective of the clean water act, within which permit for wetland is given, extenuation is described as successively averting and reducing effects and reducing effects and paying compensation for remaining effects which cannot be avoided. This chronological method is also favoured by Canada. European Commission's regulation note on article 6 of the habitats Directive (European Commission, 2000) as well makes provision for beneficial regulation on differentiating compensation from extenuation on like grounds.

In order to compensate for some of the externalities caused by intense quarrying, governments keep on revising the laws, policies and guidelines regulating stone quarrying. For example, there has been significant amendment in the policies and laws constituting the misuse of 'minor



minerals' such as sandstones in India. In 1999-2000 Section 3 of the Indian Mines and Minerals (Regulations and Development) Act 1957 (MMRD Act'57) details the minerals which are thought to be of 'minor' interest and decentralized governance from national to state level. In Rajasthan, greater quarrying concessions are no more being given and the progression of the sandstone sector, in common with other minor minerals, is based on small scale and artisanal extraction. There are properly defined processes for regaining and reinstating worked plots, with procedural rules which indicate the necessity for meticulous storage of top soil and overburden and the necessity to backfill the spent half of the concession through the usage of waste and stored material during the extraction of the second half of the quarry (Ambrose-Oji, 2009).

Together with the Government of Rajasthan the Forest Department is given the charge of extending the forest estate through the planting of new plantations or through reforestation and wasteland reclamation schemes. Under the Rajasthan State Forest Strategy there are annual targets, by District, that ranges from 10,000 – 100,000 for the number of trees to be planted, most of which are in Bundi and Kota Districts and are met through collaborative working with quarrying enterprises (Weyzig, 2006).

Reclamation is commonly considered to be the start of the end of the negative impacts from mining. The development of mining provides an economic base and use of a natural resource to improve the quality of human life. Equally important, is the fact that properly reclaimed land can also improve the quality of life. There are numerous examples of successfully reclaimed aggregate quarries, including residential, commercial, recreational, and natural uses (Arbogast et al., 2000). Many of the examples are independent of rock type. The oldest design approach around is nature itself. Given enough geologic time, a suitable small site scale, and stable adjacent ecosystems, disturbed areas may recover without mankind's input. Ursic et al., (1997) studied the Niagara Escarpment and recognized natural cliffs as special places that provide refuge for rare species of plants and animals. They also inventoried vegetation on the walls of 18 carbonate rock quarries abandoned from 20 to 100 years ago and discovered that many of the older quarry walls naturally re-vegetated in such a way as to replicate the biodiversity of natural landforms. However, in other areas, long-term natural recovery alone may not bring about the specific changes people find desirable. The natural reclamation process of abandoned quarries

can be accelerated through a process called landform replication. Through carefully designed blasting, referred to as restoration blasting, talus slopes, buttresses, and headwalls of carbonate rock quarries can be created that can be vegetated to produce landform and plant assemblages similar to those that occur on natural valley sides (Gunn & Bailey, 1993; Gunn et al., 1997).

Rwanda Stones & Construction (Rsc) Co Ltd (2011) came out with proposed extenuation measures to battle anticipated impacts of stone quarrying. This is summarized in the table 2.2.

**Table 2.2: Summary of Proposed Extenuation Measures based on Anticipated Impacts of Stone Quarrying**

#	Impacts	Extenuation measures
1	Air pollution by the fugitive emission generated during drilling, blasting, excavation, breaking and loading of the stones	<ul style="list-style-type: none"> <li>• Soil watering when soil works are being executed and where dust is emitted.</li> </ul>
2	Risk of excess soil being eroded down the wetland below the site	<ul style="list-style-type: none"> <li>• Construction of radical terraces and planting of grass and trees on those terraces.</li> <li>• Maximization of storm water harvesting and use during the dry season.</li> </ul>
3	Loss of habitat for some fauna and flora species and biodiversity reduction due to vegetation clearing	<ul style="list-style-type: none"> <li>• During land clearing, to maintain a maximum of vegetation</li> <li>• Implementation of agro forestry techniques well adapted to the site</li> </ul>
4	Risk of the accidents on the personnel of the site. Some of the workforce may not be familiar to quarrying techniques which can be a cause of accidents. If the protection equipment is not adequate accidents are most likely to occur.	<ul style="list-style-type: none"> <li>• Provide all staff on quarrying site with protective equipment (helmets, gloves, coats and boots where necessary).</li> <li>• Teach the workers the appropriate use of the equipment</li> </ul>
5	Risk of the increase of HIV/AIDS and other Sexually Transmitted Diseases due to the increase in income which may cause unsafe behaviours.	<ul style="list-style-type: none"> <li>• The biggest workforce will be recruited from the region, and they normally return to their homes.</li> <li>• Sensitization campaign to the staff on HIV/AIDS and other STDs, and avail condoms on site, free of charge</li> </ul>
6	Effects of generated solid wastes;	<ul style="list-style-type: none"> <li>• The garbage will be sorted on site and 5 categories of wastes will be treated separately.</li> <li>• Regular inspection of the site</li> </ul>

		<ul style="list-style-type: none"> <li>• Remove the degraded soil</li> <li>• Efforts will be made to utilize the solid waste to the extent possible. The non-usable part should be appropriately dumped in an officially designated area.</li> </ul>
7	Contamination of ground water by used oil from the maintenance of the machines;	<ul style="list-style-type: none"> <li>• Regular inspection of the machines</li> <li>• Used oil will be collected, stored in water tight recipients and taken to reuse or recycling plants</li> <li>• Maintain storage and disposal area to prevent accidental release</li> <li>• Provide spill extenuation equipment, double wall tanks and/or diking storage tanks</li> </ul>
8	Risk of increase in road accidents resulting from increase in road traffic;	<ul style="list-style-type: none"> <li>• Regular maintenance of the road</li> <li>• Humps added where needed.</li> <li>• Use of traffic signs</li> </ul>
9	Risk of noise pollution to surrounding population	<ul style="list-style-type: none"> <li>• Technology to be used is that which does not emit noise when blasting the rock</li> <li>• Whenever the project expects to have an increase in noise emitted, the developer will use a mobile public address system to prepare the population around 3 days prior.</li> </ul>

Source: Rwanda Stones & Construction (2011)

## 2.7 Theoretical and Conceptual Framework

### 2.7.1 Theoretical Framework

Theoretically, this study is an interplay between libertarian, egalitarian and hierarchists theories about resource governance. Fundamentally, these three diametrically opposing schools of thought are concerned with whether management of natural resources should be privatized, held by community groups or controlled by state agencies (Anaafo, 2013). The libertarians (Cooter, 1982; de Soto, 2000; Demsetz, 1967; The World Bank, 2002, 2013) are of the view that the goals of resource governance, often construed to include efficiency and equity are only attainable when their management is dictated by market forces. This position is the Gareth Hardin's school of "the tragedy of the commons" who argued that resources held and used in common by a group of

people are prone to degradation as everyone tries to draw from the resource in a limitless manner in a world that is limited (Hardin, 1968).

Egalitarians, however, have often argued that the management of land and natural resources is better undertaken by institutions other than the state and/or the market. The argument advanced by this group of theorists is that efficiency and equity in resource governance is better delivered when community institutions are in charge of the resource governance processes. This has been the positions of (Dolšak & Ostrom, 2003; Ostrom, 1990; Ostrom et al., 2002), who perceive land as a common pool resource and argue that access to natural resources is better facilitated by local communities. Ostrom (1990) particularly observes that we are often too quick to prescribe that either the state or the private sector takes up the management of natural resources to prevent their destruction. She argues, however, that neither the state nor the market have been successful over the years in uniformly ensuring long-term sustainability in natural resource use and that communities have achieved relative success in the governance of resources over longer time periods by relying on institutions other than the state or the market (Ostrom, 1990, p. 1). The egalitarians have often argued that privatizing and/or commercializing land resources has the potential of destroying the social fabric of communities as it replaces community principles of cooperation and solidarity with those of competition (Long et al., 1999).

The position that natural resources use be regulated by government has been around since the days of Locke – the English philosopher and physician whose writings had a significant influence on Western philosophy. It has been suggested by Locke that in instances of misunderstanding and conflicts among various individuals and social groups over natural resources access and use, government by virtue of the social contract it has with the people must intervene presumably through negotiation, mediation and appropriate resource policy (Locke, 1698 cited in Davy, 2009). The position of the hierarchists in seeking secure resources rights for all is expressed in terms of rights:

*“With all due respect to customs and traditions, it is each government’s obligation to ensure that land (natural resource) management is not discriminatory, particularly with regard to women and the poor, and does not violate other human right” (UN Habitat & GLTN, 2008, p. 12) (my emphasis).*

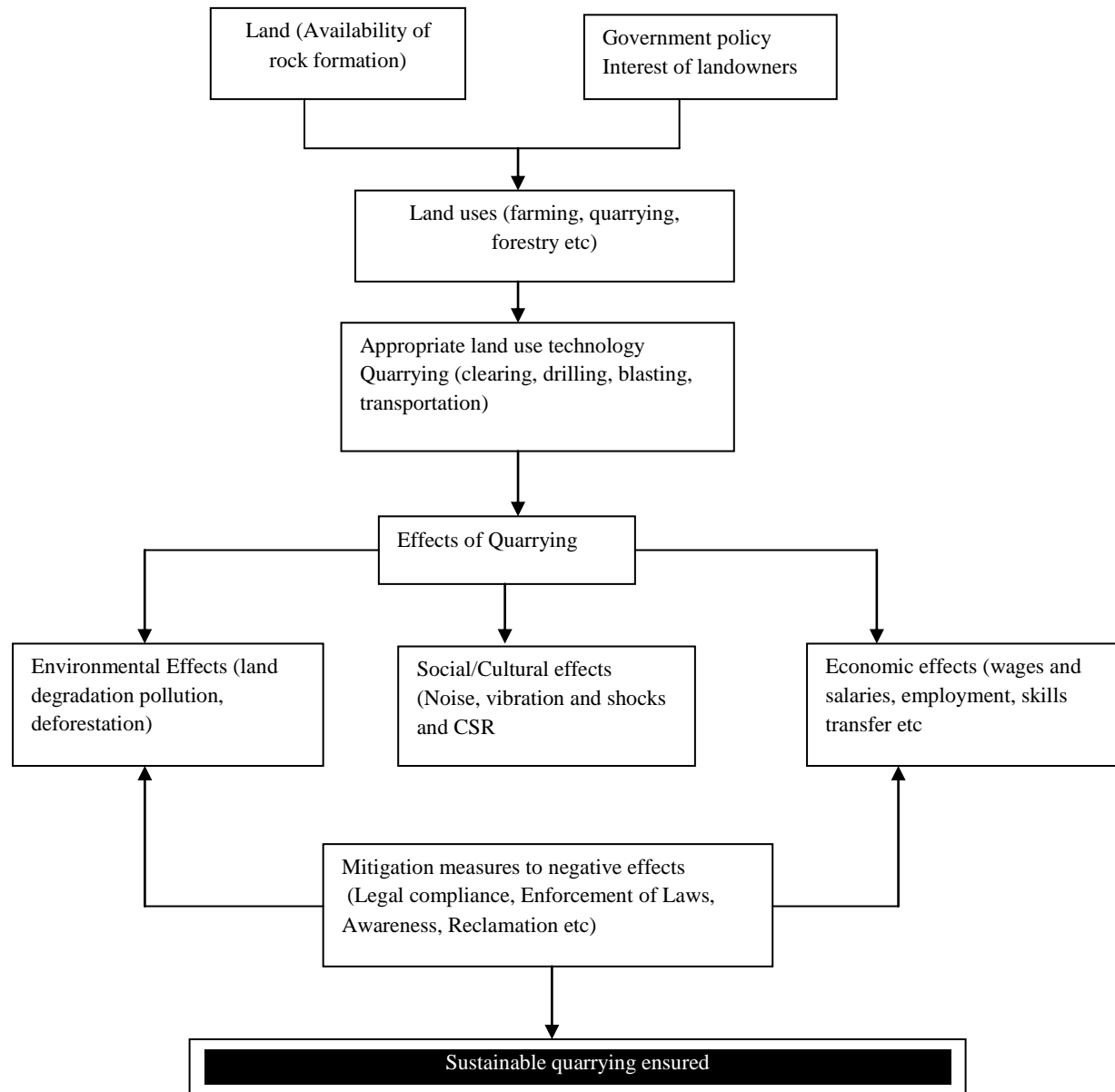
The Centre for Sustainable Development (CSD, 2008), a pioneering voice in this arena have indicated that with growing population pressures, economic development and urbanization driving demands for food, water, energy and raw materials, national governments have the ultimate responsibility to supervise the sustainable delivery of natural resources in a manner that addresses the needs of various interests groups. They argue that securing reliable natural resource data and adapting technologies that suit local conditions are crucial to sustainable resource management, arguing that these are achievable when governance systems are bolstered through institutional capacity building programmes.

The Government of Ghana together with land owners in the Wenchi Municipality decided that the best way to make the natural resources (rock formations) in the Municipality productive is to put it into the hands of private investors. This will therefore be seen to be situated in the libertarian approach to resources governance. This research therefore seeks generally to understand the extent to which measures can be put in place to ensure that the capitalist accumulative interest of investors is not detrimental to the livelihoods of community members. It also seeks to examine the extent to which private investors are conducting their quarrying activities sustainably by balancing profit motives with community interests and ensuring a mutual balance between environmental, economic and social goals of communities. The next section details the conceptual framework which guides this research.

### **2.7.2 Conceptual framework**

Conceptually, the goal of this study is that quarrying companies conduct their operations in a sustainable manner. The Wenchi area is already well endowed with the natural resources required to attract quarrying companies into the area. Government's neo-liberal approach to resource extraction, together with the interests of land custodians have ensured that a number of companies have secured leases to operate quarries in the Wenchi Municipality. This has created a municipal landscape with diverse land uses ranging from peasant and commercial farming, forestry, quarrying and small scale mining among others. All these activities, it is argued in this research must, however be undertaken using appropriate technology if there is the objective to have positive effects on local livelihoods.

This study critically examines quarrying, which is one of the dominant land use options in the municipality to ascertain the extent to which it impacts the livelihoods of the various community actors. This is done within the variables of environmental, social and economic indicators. It seeks to understand how quarrying impacts on peoples income, employment, social cohesion and environmental viability. Through such an analysis, proposals for minimizing the effects and maximizing the benefits from quarrying for local community members in the Wenchi Municipality are made. Figure 2.1 is the conceptual framework guiding this research.



**Figure 2.1: Conceptual Framework**

**Source: Author's Construct, 2015**

## 2.7 Conclusion

The literature has revealed that stone quarry companies are major contributors in terms of employment, provision social amenities and other form of support and payment of royalties and rates to most of the host communities, districts and the country at large. This therefore complements the government's poverty reduction agenda. Thus, stone quarry companies play

impeccable roles in national development. However, the mode of operations adopted for the quarrying activity may pose a number of environmental, health and social-economic effects to host communities especially where communities depends largely on agriculture for their livelihood. Sustainable development measures therefore needs to be adopted and applied in the extraction of the product.

The theoretical framework together with the research objectives provided some options for the development of a research methodology that can assist in responding to the objectives sought in the context of the Wenchi Municipality. The next chapter would then address the methodological approaches used to collect and analyze data. It is also significant to present more information of the Wenchi Municipality, its unique characteristics and peculiarities to make possible an in-depth investigation.



## **CHAPTER THREE**

### **PROFILE OF STUDY AREA AND RESEARCH METHODOLOGY**

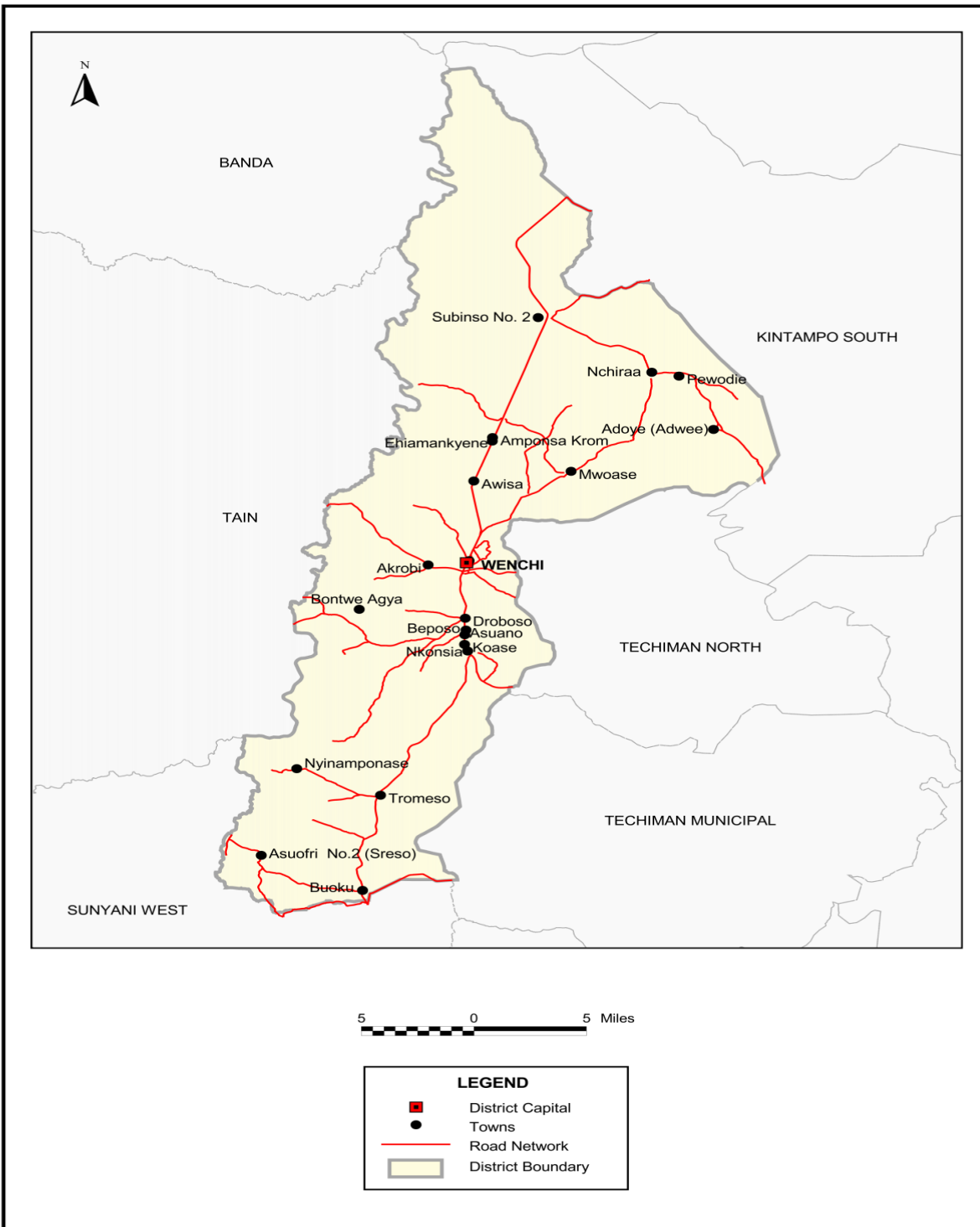
#### **3.1 Introduction**

Following the successful review of literature relevant to this research is the presentation of the profile of this research area and the research methodology employed in eliciting relevant and accurate information for purposes of this research. The profile is broadly summarized under physical, human and economic environments. The research methodology details out issues such as; research methodology, research design, unit of analysis, sampling procedure, sample frame and sample size determination, data sources, data collection modes and data analysis.

#### **3.2 The Wenchi Municipal Assembly (Study Area)**

The Wenchi Municipal Assembly is located in the Brong-Ahafo Region. It is approximately 56km from Sunyani the regional capital of Brong-Ahafo. The municipality shares boundaries with Banda and Kintampo South Districts to the North, Tain District to the West, Techiman and Sunyani Municipal to the south and Techiman North to the east. It lies within latitudes 7° 30' South and 7° 15' North and longitudes 2° 17' West and 1° 55' East. Figure 3.1 shows the map of the Wenchi municipality (Wenchi municipal Assembly, 2010).

Wenchi Municipal Assembly covers a total land area of 1,296.6km<sup>2</sup> and is composed of an estimated number of 150 dispersed settlements. The Municipality is fairly low-lying rising gradually from 30m above sea level. It lies within the transitional belt of Ghana and as such exhibits the characteristics of both the Southern forest zone and the Northern savannah belt. The Municipality experiences a bi-modal rainfall pattern with a mean annual rainfall level ranging between 1,140 – 1,270mm. The major rainy season occurs between the months of March to July, with the minor season occurring between September and November. The area experiences prolonged drought from December to March (Wenchi Municipal Assembly, 2010).



**Figure 3.1 Map of Wenchi Municipality**

Source: Ghana Statistical Service, GIS, 2014

### **3.2.1 The Physical Environment**

The Wenchi Municipality until recently was part of the forest zone of Ghana. Poor agricultural practices, bush burning and excessive timber exploitation have combined to turn large sections of the municipality into a savannah ecosystem. As a result the Municipality is currently characterised by two distinct soil categories - one developed under forest vegetation and the other developed under savannah vegetation. Soils of the area are generally suitable for the cultivation of many different kinds of tropical crops (Wenchi Municipal Assembly, 2010).

Lands in the Wenchi Municipality are owned by families but vested in the chiefs symbolised by stools. Access to land is strictly by inheritance along family lines, rentals and outright purchase. The major natural resources available to the people are the relatively good agricultural soils, the natural rivers of Subin, Kyiridi, Trome, Tain and Yoyo which offer potentials for the development of irrigational facilities for agricultural productivity. While land is said to be readily available, high rents and soaring land values are making land inaccessible to the majority of small scale farmers. Indigenous households have also had to reduce fallow periods and adopt sedentary agricultural practices due to growing land scarcity (Wenchi Municipal Assembly, 2010).

Geologically, the municipality is underlined mostly by Birrimain rock formation. The area falls under the Lower Birrimain, which consists of such metamorphosed sediments as phyllite and schist. There are also granite and granodiorite in the southeast and western parts of the Municipality. Figure 3.2 below shows the geological map of the Wenchi Municipality. These rock deposits and outcrops are within the stretch of land between Wenchi Town, Papaasu, mensahkrom, Ayaayo, Bepotrim, Abrefakrom, Kokoosu and Buoku communities. The availability of the raw material for the production of building and construction products like quarrying dust, chippings and among others has attracted a number of quarrying companies rocks are currently being quarried for road and building construction. There are over Six (6) large scale companies in the municipality that are mining these rock deposits. The proliferation of these quarrying companies into the Municipality necessitated this study.

### **3.2.2 The Human Environment**

The 2010 Population and Housing Census Report of Ghana, puts the total population of the Wenchi Municipality at 89,739. This is broken down into 44,065 males and 45,674 females. The

annual population growth rate is estimated at 2.3 percent and a population density of 69.2. (Ghana Statistical Service, 2010).

The Wenchi Municipality is predominantly rural. It is estimated that 63 percent of the total population live in rural areas, while 37 percent live in urban settlements. The Municipality by virtue of its location and rich agricultural soils is a net recipient of migrants. While the records are contradictory, some reconciliation indicates that about 32.5 percent of the total populations of the Municipality are migrants from within and without Ghana. The dominant ethnic group (51 percent) is the Bonos, the indigenous people of the area. While 65.5 percent of the population are Christians, 21.7 percent are Muslims and 3.7 percent are Traditional African believers (Wenchi Municipal Assembly, 2010).

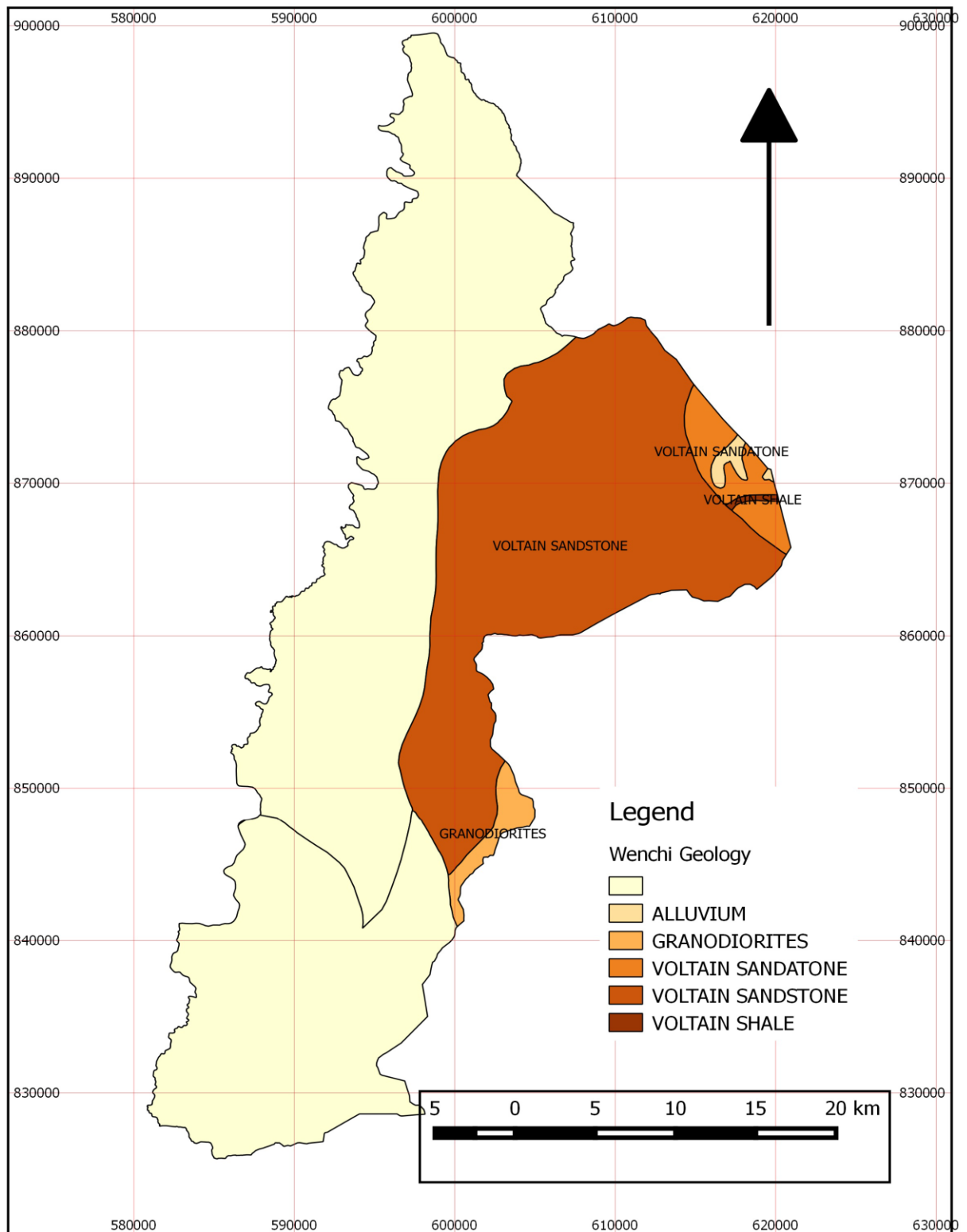
The extended family system is still a dominant cultural practice in the Wenchi Municipality although it is gradually giving way to the nuclear family system. Predominantly, inheritance is matrilineal and children are expected to inherit the properties of their uncles. This practice, however, is fast giving way to patrilineal inheritance. The traditional chieftaincy system remains the most powerful symbol of authority within Wenchi (Wenchi Municipal Assembly, 2010).

### **3.2.3 The Economic Environment**

The Municipality of Wenchi is predominantly agrarian. The Agricultural sector employs 57.8 percent of the active labour force in the Municipality. It is followed by commerce with 17.5 percent; service with 15.2 percent and industry with 9.5 percent (Wenchi Municipal Assembly, 2010). Agrarian activities comprise both cultivation of crops and rearing of animals as well as commercial and subsistence farming. The major food crops cultivated include maize, yam, cassava, cashew, and plantain. It is estimated that a total land area of 99,875 hectares is under cultivation of these major food crops. The animals reared are predominantly cattle, sheep, goats pigs (Department of Agriculture, 2013).

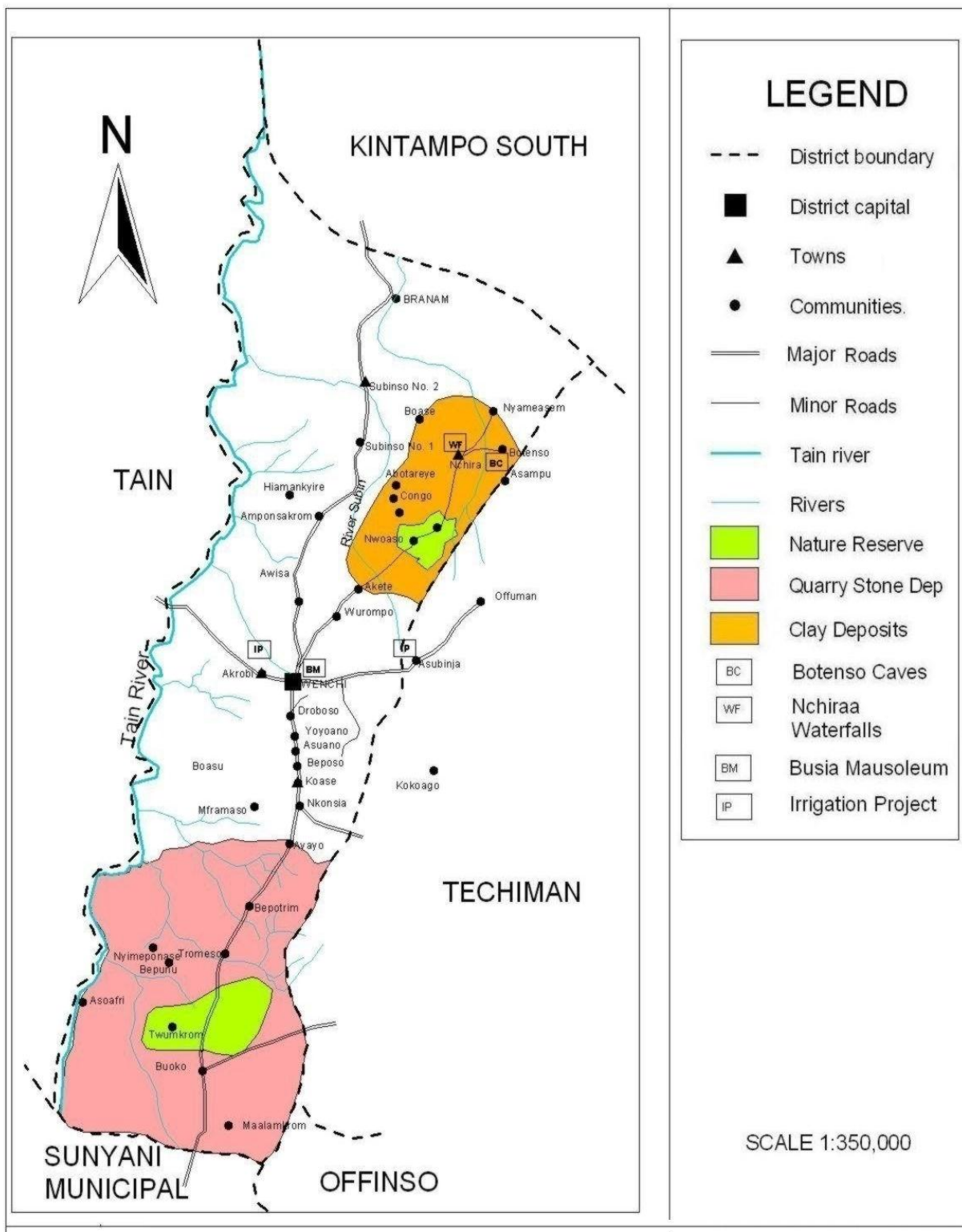
Quarrying is also a major provider of jobs (directly and indirectly) for the majority of inhabitants in the Wenchi Municipality. While official records were scanty on direct and indirect employment levels in the quarrying industry, a reconciliation between company records and those of workers unions indicate that about 1,598 people earn their livelihoods from their direct

and/or indirect involvement in quarrying. Quarrying also occupies a total land area of 432.2.km<sup>2</sup> (Wenchi Municipal Assembly, 2010). Figure 3.3 shows the resource potential of the Municipality.



**Figure 3.2: Geological Map of the Wenchi Municipality.**

Source: Wenchi Municipal Assembly, 2010



**Figure 3.3: Resource Potential of Wenchi Municipality**

Source: Wenchi Municipal Assembly, 2010

### **3.3 Research Methodology**

Strauss & Corbin (1990) describe methodology as a way of thinking about and studying a social reality; stressing that the methodology gives a vision to what the research should involve. Methods, on the other hand are a set of procedures and techniques used for gathering and analyzing data. It is through these techniques that the analysts see the ordinary and are able to arrive at new understanding of social life.

The success and the ability to achieve the objectives of a given research depend largely on the design and control of the research process. Besides, results quality equally rest on the source of data, how the data is collected, processed, analyzed, and presented.

#### *3.3. 1 Research design and rationale*

Research design denotes plan for conducting research which usually specify variables to be examined and the procedures to be used with the motive of providing appropriate answers to the research questions (Sparrow, 1988). Research design plans, manages and systematizes quantitative or qualitative data collection. This survey adopts a case study approach to carry out the research focusing on the operational methods, effects and mitigating measures of quarrying in the Wenchi Municipality.

A case study according to Yin (1994) is empirical inquiries that investigate a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used. A case study is an in depth study of a particular situation rather than a sweeping statistical survey (Martyn, 2008). Adopting the approach means that, this research will go beyond quantitative statistical results and provide qualitative explanation of conditions. This approach employs both quantitative and qualitative data that helps explain both the process and result of an event through complete observation, reconstruction and investigation of the cases under study. The case study approach was adopted because it allows for detailed contextual investigation of a limited number of phenomenon and their relationships. This was to get a holistic and in-depth view of what the situation was, using Wenchi Municipality as a point of reference.



### *3.3.2 Unit of analysis*

In research, the unit of analysis is the empirical units, objects and occurrences which must be observed or measured in order to study a particular phenomenon (Kumekpor, 2002: p.54). Frankfort-Nachmias and Nachmias (1996) observe that unit of analysis is the most elementary part of a phenomenon being studied. In view of these definitions, the units of analysis for this study were households directly or indirectly affected by the quarrying activities, quarry workers, key informants, chiefs and Assembly members in the quarry area. The others were the Environmental Protection Agency (EPA), Wenchi Municipal Assembly (WMA), the Quarrying companies and the Wenchi Traditional Council (WTC).

### *3.3.3 Sampling Procedure*

This research though was a municipal wide activity; opinions were solicited from eight (8) communities who host quarry companies in the Wenchi municipality namely: Buoku, Abrefakrom, Paapasu, Bepotrim, Mensahkrom, Ayaayo, Amoakrom and Kokoosu. Both non-probability and probability sampling techniques were used in this research. With regard to non-probability sampling methods, purposive sampling technique was used to select communities that host or are affected mostly by quarry activities. After having purposively selected these communities, the simple random sampling technique was applied in the selection of household respondents for the administration of structured and semi-structured questionnaires in the respective communities. The houses in the research communities were assigned serial numbers and put into a container and mixed. I then closed my eyes and randomly picked the numbers from the container one by one until the required number of questionnaires to be administered in that community is up. This was repeated in the remaining study communities to arrive at the sample of 90. The simple random sampling was used to avoid bias by giving all units in the target population equal chances of being selected. Again, there is increased likelihood that the data collected are a representative of the whole population through the use of simple random sampling.

Furthermore, purposive sampling technique was again used to identify key informants who were interviewed. The key informants included; Assembly members, Chiefs, landlords, quarry operators/companies, the Wenchi Traditional Council and Environmental Protection Agency. The purposive selection of key informants was important because it provided in-depth and

proficient information about the stone quarrying in the Wenchi Municipality. They also play various roles in granting concessions, environmental permits and issuing of guidelines for the operation of the companies. Royalties and taxes or rates are received by the Assembly, Environmental Protection Agency and Traditional Authorities.

As already indicated eight (8) communities were purposively selected due to their closeness to the quarry companies and 90 Households were randomly selected and interviewed from the eight (8) communities. With data from the Ghana Statistical Services on the population and number of households the eight (8) communities the sample size was determined and from the sample size the questionnaires were distributed proportionally among the eight (8) communities that are very close to the site of the quarrying companies.

The top level management of all the quarrying companies operating in the municipality that is (J.A Quarry, Britak Quarry, Vision, Stardust, Taysec and Nsemere Quarry) were interviewed. And this provided relevant information on extenuation measures, methods adopted for quarrying and effects associated with their operations in the Municipality. A total of One hundred and forty (140) questionnaires were administered in all. Table 3.2 gives details of the number of questionnaires that were administered.

#### *3.3.4 Sampling Frame and Sample Size Determination*

Sample frame is the actual list from which the sample size is selected. For purposes of the research, the sample frame for this research was the total number of households in the eight (8) communities, that are most affected by quarrying as indicated in table 3.1. The total population from the 8 communities is 4747 which translated to 863 households according to data from the 2010 population and housing census. The number of households was used as the sample frame since this research was to elucidate data from household. From the sample frame of 863 households in the eight (8) communities this research first employed a statistical model to arrive at the ninety (90) households that were interviewed as the representative sample size at 90 percent confidence level with 10 percent margin of error.

$$n = \frac{N}{1 + N (\alpha)^2}$$

$$\text{Therefore, } n = \frac{863}{1 + 863 (0.1)^2} = 90 \text{ Households}$$

Where

n = Sample Size

N = Sample Frame

1 = Constant; and

$\alpha$  = Confidence Level.

Having successfully determined the sample size, the sample size was proportionally distributed among the eight (8) communities (See table 3.1) with the help of a statistical model. This was to ensure that the questionnaire were administrated based on the number of households in each community. Table 3.1 depicts the samples in the various communities by the use of the statistical model.

$$Q_n = \frac{p}{N} \times n$$

$$\text{Therefore, } Q_n (\text{paapasu}) = \frac{12}{863} \times 90 = 1 \text{ Household}$$

Where

Qn = Number of questionnaires to be administered in each community

p = Number of households in each community

N = Sample Frame

n = Sample Size

**Table 3.1 Sample Size Determination for the Selected Communities**

Communities	Population (2010)	Total Number of Households	Sample Size	Number of Questionnaires Administered	Response Rate (%)
Papaasu	71	12	1	1	100
Bepotirim	550	117	12	12	100
Buoku	1531	312	33	33	100
Abrefakrom	891	143	15	15	100
Mensahkrom	464	43	4	4	100
Kokoosu	321	63	7	7	100
Ayaayo	415	78	8	8	100
Amoahkrom	504	95	10	10	100
<b>Total</b>	<b>4747</b>	<b>863</b>	<b>90</b>	<b>90</b>	<b>100</b>

Source: Ghana Statistical Service, 2010 and Field Survey, December, 2014.

### *3.3.5 Data Sources and Data collection Methods*

This research used both secondary and primary sources of data to elucidate the required responses to the research questions. The secondary sources included both published and unpublished reports on topics related to quarrying activities. Journals and reports provided the general effects, methods employed in quarrying. The conceptual issues that were derived from the secondary sources of data included the meaning of the concept of stone quarrying; methods of stone quarrying, the effects of quarrying under the broad headings of environmental, social and economic. The linkage between environment and sustainable development; principles for sustainability on quarrying; legal and regulatory framework on mining were discussed with the help of secondary data.

Furthermore, the secondary sources revealed some of the positive effects stone quarry can offer in terms of employment and provision social of amenities like water and schools blocks. However, with majority of the municipality's population engaged in agriculture and depending on farming for their livelihoods, secondary sources provided the potential negative effects associated with stone quarrying. Lastly, extenuation and compensation measures to the potential effects were gathered through secondary sources. This gave the researcher a fair idea of how the potential effects may be managed.

The primary data were also gathered through the researcher's observations and interviews that were carefully granted with respondents using semi-structured interview guides. The sources of the primary data included Households, Assembly member, Chiefs and Opinions Leaders in the host communities and Quarrying companies under the units of analysis. The other sources of primary data were the Wenchi Municipal Assembly (WMA), Environmental Protection Agency (EPA), and Wenchi Traditional Council (WTC). Primary and secondary sources of data were thus used as complements.

In gathering the primary data, a total number of 140 questionnaires were administered to the respondents. Tables 3.1 and 3.2 present details of the number of questionnaires administered.

**Table 3.2 Summary of Questionnaires Administered**

<b>UNIT</b>	<b>NUMBER OF QUESTIONNAIRES</b>
HOUSEHOLDS	<b>90</b>
ENVIRONMENTAL PROTECTION AGENCY	<b>3</b>
TRADITIONAL AUTHORITIES	<b>9</b>
MUNICIPAL ASSEMBLY	<b>8</b>
KEY INFORMANTS/ OPINION LEADERS	<b>24</b>
QUARRY COMPANIES	<b>6</b>
<b>TOTAL</b>	<b>140</b>

Source: Field Survey December, 2014.

#### *3.3.6 Data Analysis*

Data collection in research is incomplete without analysis, interpretation and presentation of findings. Data analysis involves analyzing the detailed questions and extracting relevant portions of the questionnaires that will be useful to this research. Data analysis was done at two levels – quantitative and qualitative. Both processes were, however, preceded by editing and coding before data presentation. The purpose was to scrutinize the completed data collection instruments to identify and minimize possible errors, incompleteness, misclassification and gaps in information received from respondents. As Kumar (1999) contends, the cleaning of data revolves around issues such as forgotten questions, unrecorded responses, half-written answers; and illegible writings.

Quantitative data were analyzed using tabulations, frequencies and percentages while Qualitative analysis was done for data generated from open-ended questions in the structured questionnaires. Descriptions and narrations of people's views on effects of stone quarrying, extenuation measures and sustainable stone quarrying practices are conveyed.

### **3.4 Conclusion**

The physical, human and economic characteristics of Wenchi Municipality as discussed in this chapter are important for understanding the context within which this research was conducted. It also helps to appreciate the various influences likely to play out with regards to stone quarrying

activities. From the discussion one will notice that a study must be cautiously planned and well carried out in order to address the objectives the research has set for itself. The chapter spelt out the context within which sampling was carried out and as well how the data was gathered and interpreted. These therefore lead to the presentation and discussion of results from this research area. The next chapter seeks to analyze and discuss the results from the field work conducted.

## **CHAPTER FOUR**

### **DATA PRESENTATION AND ANALYSIS**

#### **4.1 Introduction**

Preceding this chapter is the profile and research methodology adopted to collect data for this study. This chapter therefore presents results and discussion based on the research questions and the objectives set out in the study. It basically covers the background of the respondents, operation methods employed by quarrying companies in extracting the quarry products, the social, environmental and economic effects of quarry operation on the community and the mitigation measures being adopted by the quarrying companies to manage the potential negative effects.

#### **4.2 Background of Household Respondents**

Data was collected across all the communities where quarrying is being carried out. The opinion leaders/key informants and community members were interviewed evenly to enable an adequate understanding of the situation on the ground. This section of the study therefore presents the background of the household respondents in terms of sex, age, educational and occupation characteristics and income levels. The rationale of this information is to put the research into context.

##### *4.2.1 Age and gender of household respondents*

Age and gender are very central to the analysis of any kind of situation existing in a particular area as the area may be inhabited by both sex and different age groups. Knowledge about the gender and age structure of the area under study provides vivid dimensions of the problem and the category of people, who are affected by it, hence provide entry point in analyzing the situation. Both sexes and different age groups stayed and carried out economic activities in the Municipality so there was the need to give them equal opportunity to respond to the interview schedules. Again, the age of respondents was significant in this study since it was to make sure that children were excluded from the study. This would enable the researcher collect adequate and relevant information on assessing the effects of stone quarrying in the Wenchi municipality.

A total 88 of the community household respondents representing 97.8 percent were in the youthful age of 20 – 60 years as presented in Table 4.1. The youthful nature of the population in the quarrying communities require that measures are put in place to deal with the provision of employment opportunities, educational infrastructure, reliable power supply for recreational activities, as well as adequate water and sanitation facilities to meet the demands of the youth.

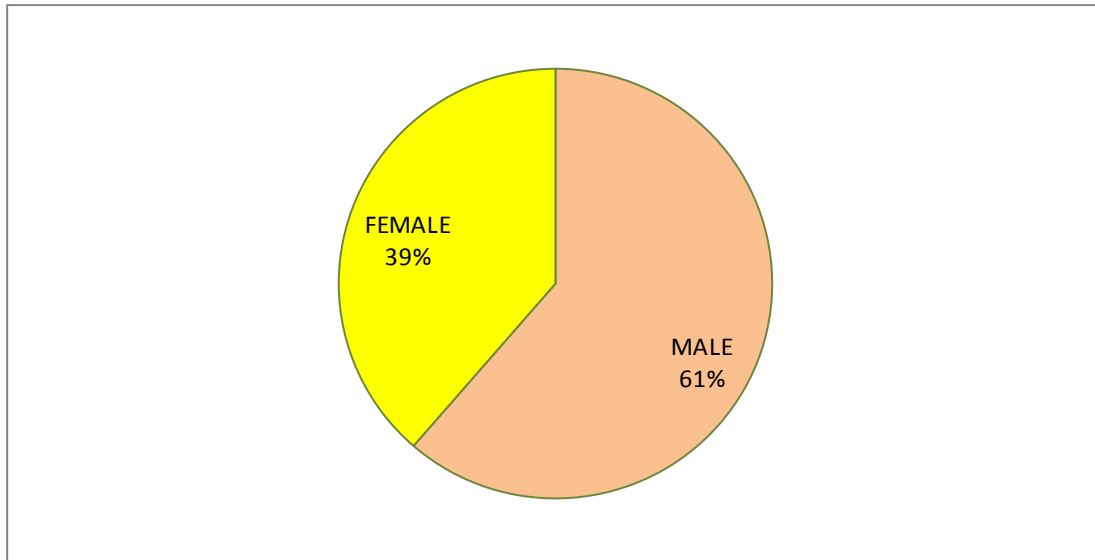
Of the 90 sampled household respondents from the eight (8) communities, majority of 61 percent were males as shown in Figure 4.1. Also, the key informant interview in the communities had 24 respondents with 3 from each of the quarry communities. This sex disparity in the community and key informant interview came about because of the fact that most males predominate as household heads and this is not common in many Ghanaian society where males are perhaps responsible for the upkeep of the household. Another reason may be that females felt issues concerning quarrying were related to men and on this basis they allowed their husbands to be interviewed when their households/the individuals were selected. The males to some extent did not have much problem at all responding to interviews and this accounted for their dominance in this study. The minimal number of females that act as household heads was as a consequence of they being single, separated, divorced or widowed.

**Table 4.1: Age and Gender of Household Respondents**

<b>Ages</b>	<b>Respondent</b>		<b>Total</b>	<b>Percentage</b>
	<b>male</b>	<b>Female</b>		
20 - 29	24	17	41	45.6
30-39	20	13	33	36.7
40-49	7	4	11	12.2
50-59	2	1	3	3.3
60 and above	2	0	2	2.2
<b>Total</b>	<b>55</b>	<b>35</b>	<b>90</b>	<b>100.0</b>

Source: Field Survey, December, 2014.





**Figure 4.1: Gender Composition of Household Heads**

Source: Field Survey, December, 2014.

#### *4.2.2 Educational Background and Marital Status of Household Respondents*

The educational background is very crucial in studying any phenomena about a group of people as their level of education to a larger extent influences how they perceive and approach things. In this regard, educational background of the respondents was also taken into consideration during this research. This was due to the fact that it could be a factor in influencing respondents' opinion on quarrying and the effects the activity poses to community members. This research discovered that 11 percent of the respondents had no formal education, 48 percent of the respondents had some kind of education from basic level as shown in Table 4.2 whilst 31 percent had secondary/middle level education. Ten percent (10%) of the respondents had tertiary education. On the whole the educational attainment level is quite good among the host communities with over 70 percent of the people interviewed having some form of education. This situation facilitated the collection data of as the majority of the respondents administered the household questionnaires themselves. It also shows how the communities sense of appreciation of towards education.

Marital status could influence family pressure on the respondents and the need to undertake activities to earn incomes. This research revealed that, 60 percent of the sampled community

members were married as indicated in Table 4.2. This implies that they had a lot of responsibilities on themselves, which could force them to farming, burn charcoal and even engage in quarrying, just to support their families. With majority of the respondents been farming it implies there will be conflict with regards to land. Whiles farmers may need land to cultivate their crops and other activities, quarrying companies will need land to produce quarry products.

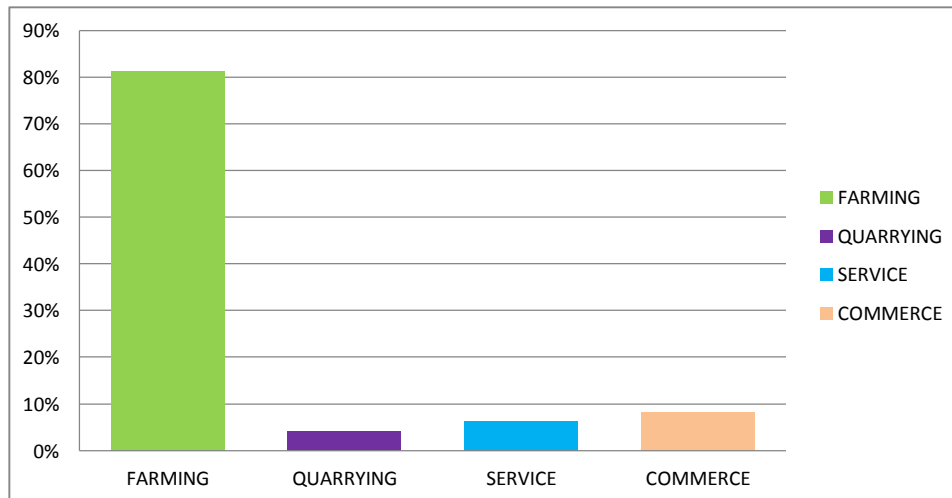
**Table 4.2: Educational Background and Marital Status of Household Respondents**

Education level	Marital Status			Total	Percent
	Single	Married	Divorce/ Windowed		
Basic	12	27	4	43	47.8
Secondary/middle	13	15	0	28	31.1
Tertiary	5	4	0	9	10
Never	0	8	2	10	11.1
<b>Total</b>	<b>30</b>	<b>54</b>	<b>6</b>	<b>90</b>	<b>100.0</b>

Source: Field Survey, December, 2014.

#### *4.2.3 Occupation of Household Respondents*

The educational background of people to some extent determines the types of occupation the people are engaged in. It can be ascertained from figure 4.2 that, majority (81.2%) of the household respondents interviewed are engaged in farming while 8.3 percent also make their living through commerce. With farming being the main source of livelihood of the people of the host communities any environmental activity that reduces the fertility of the land may plunge a large section of the community members into abject poverty. Though, a meager percentage of 4.2 of the respondents are working in the quarrying companies and earn income for their family up keeps, there is the need to ensure that the products are sustainably mined without compromising of the livelihood of the host communities.

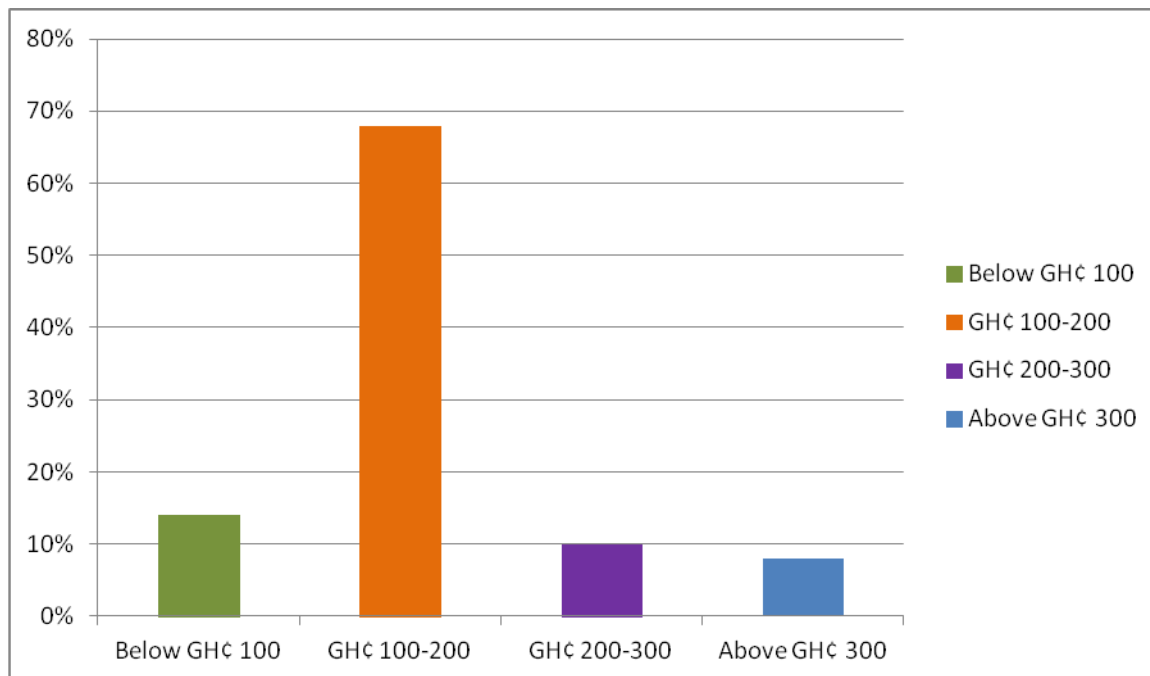


**Figure 4.2: Occupation of Household Respondents**

Source: Field Survey, December, 2014.

#### *4.2.4 Income levels*

The income levels of the respondents were investigated during the survey. It was revealed by the field survey that the income levels of the people living in the communities around the quarrying companies were generally low. As shown by Figure 4.3, only 7.6 percent of the respondents earned monthly incomes above GH¢300.00 with the majority, 67.8 percent earning between GH¢ 100.00 -200.00 a month. The few people earning above GH¢ 300.00 were mostly salary workers whereas those earning between GH¢ 100.00-200.00 a month were found to be the peasant farmers.



**Figure 4.3 Income Levels of Household Respondents**

Source: Field Survey, December, 2014.

#### **4.3 Methods Used in Quarrying**

One of the main objectives of this research was to identify the methods of operation employed by the quarrying organization in the extracting the minerals. This was important as it will give the researcher the opportunity to assess whether the quarry companies were using acceptable methods in their operations in line with Environmental Protection Agency and International principles. The methods used in quarrying also gave the researcher a fair idea about the potential effects the activities will pose to host communities

From the six companies visited and interviewed, this research revealed that the predominant method of extracting rock products in the municipality is the open pit or open cast quarrying. The open pit quarrying is a process of digging rocks or minerals from the earth by their elimination from an open pit or burrow. The open pit is the preferred method used in extracting the rock products in the municipality because deposits of commercially viable minerals or rocks are found close to the earth's surface in the municipality, hence the justification to use the open pit or open cast method in extracting the rock products.

Having looked at the predominant method used in extracting rock products in the municipality, the research went further to establish the main processes that are carried out in the open cast method to ascertain the final or desired rock sizes or aggregates. From the survey, it was brought to light that the quarrying companies operating in the municipality employ a range of processes in exploiting the rock products. It was, however, discovered that the method of extraction to a large extent depends on the nature of rock, rock formation and the structure of the earth surface. From the field survey, five main processes were employed in extracting the rock products. These are drilling, blasting, wedging excavating and crushing. The processes used are elaborated in the subsequent paragraphs.

The initial process employed in quarrying is the process of excavation. This is done following the discovery of a suitable mother or burden rock, which is deemed exploitable by the quarries. This process is employed by the quarrying companies in the municipality when the newly discovered stones to be quarried are lying buried in the earth or under loose overburden. The activity becomes necessary to expose the overburden rock and makes the exploitation of the rock product possible. The main and most sophisticated device or machinery usually employed in undertaking the excavating works is the excavator. Other simple tools such as shovels, pick axes, hammers, and chisels are occasionally employed for excavation.

Having carried out the excavation works, the second process adopted by the quarrying companies in the municipality is the drilling operation. Drilling involves the creation of deep holes in the overburden rock deposits. With the use of a driller and chisels, deep and larger openings or holes are created to pave way for the blasting and subsequent exploitation of the rock products.

The third process employed in quarrying is the process of wedging. This method is suitable for quarrying soft stratified rocks. The operation starts near a vertical face created by cutting a channel in the rock. Steel hammers called sledge are simultaneously put into the holes to split the slab along the line of holes drilled.

Following the wedging process is the activity of blasting. The activity involves the blasting of larger rock deposits with the aid of explosives. The operation of blasting involves the boring and drilling of holes and putting more powerful explosives like dynamite into the holes. The diameter and the depth of each hole depends on the quantity and nature of rock to be loosened and the type and quantity of explosives used. After the explosives are inserted, it takes quite some time before the overburden rock deposits finally blast or disintegrate into smaller rock particles that are desired.

After blasting, the rubbles are conveyed by earth moving equipment to the main crushers where it is crushed into different sizes according to market demand. Crushing involves the breaking down or the disintegration of rock products into desired sizes and aggregates. The crushed material is then segregated size-wise by screening, awaiting potential buyers.



**Plate 1. A Pull Loader Filling a Crusher with Blasted Stone Products and Mobile Ridge, Britak Quarry site, Bepotrim.**

Source: Field work, December, 2014.

#### 4.4 Tools and Devices used in Quarrying in the Municipality.

From the survey, it was noticed that both simple and sophisticated tools/ equipment are used to carry out processes of quarrying in the Wenchi Municipality. Large scale quarrying companies in the municipality uses much more sophisticated and expensive devices to make production and productivity more effective and efficient.

The equipment and devices used for processes of quarrying in the municipality are in sync with some of the tools mentioned by Redmond (2005) in the literature review. Langer (2001) and Priyadarshi (1998) also suggested that in open cast method, equipment such as excavators, pull loaders and chisels are devices used in carrying out processes of quarrying. Table 4.3 gives a summary of both simple and sophisticated devices used in quarrying.

**Table 4.3 Tools and Machines used at Quarries**

<b>SIMPLE TOOLS</b>	<b>SOPHISTICATED EQUIPMENT</b>
Spanner	Extension Rod
Hammer	Button Bitch
Chisels	Mobile Ridges
Shovel/ Spade	Welding Machines
Chain Block	Crushers
Wheel Barrow	Excavators
	Compressor with Jack Hammer
	Explosives (Dynamite)
	Pull Loaders
	Loading Trucks
	Bulldozers

Source: Field Survey, December, 2014.

#### 4.5 Identified Effects of Stone Quarrying

This research sought to assess the effects of stone quarrying on the municipality as a whole, but much attention was paid to the host communities. Structured and unstructured questionnaires and interview guides were therefore designed to collect data from quarrying companies, host communities and institutions that are involved in quarrying. This was to identify and bring to light the effects of stone quarrying on the municipality, particularly, the surrounding

communities. This section of the research discusses the outcomes under the broad headings; environmental, socio-cultural and economic effects of quarrying.

#### **4.5.1 Environmental effects of quarrying**

A number of environmental effects associated with stone quarrying were identified during the field survey. Some of the pronounced environmental effects are elaborated in the subsequent paragraphs.

- *Land Degradation and Loss of Top Soil*

It was observed from the field survey that quarrying has a negative environmental consequence on the natural environment by way of forest degradation and loss of fertile top soil. There were evidence of deep large pits, trenches and deep gullies, resulting from the excavation activities. These large pits had been created due to continuous and sustained extraction of the rock products. It was revealed from the field survey that no measures have been put in place by the quarrying companies to reclaim the degraded lands as a result of their activities. These large pits have therefore served as breeding grounds for mosquitoes, especially during the rainy season. These large pits do not only reduce the aesthetic beauty of the environment, but also pose a serious threat to the lives of workers and other people in the host communities. There was evident of loss of biodiversity as the quarry companies cleared vegetation to expose the rock material for extraction. Clearance of vegetation also led to soil erosion down the slopes. Several gullies and trenches had been created along the roads linking the quarry sites as a result of persistent and sustained removal of the top soil.





**Plate 2: Degraded Lands Resulting from Quarrying, Nsemere Quarry site, Mensakrom**

Source: Field Survey December, 2014.

- *Noise Pollution and vibration*

Another negative environmental effect the survey revealed was severe noise pollution and sustained vibration, culminating from the blasting of rocks. The main cause of noise was from the excavation, drilling, blasting and movement of loading vehicles. Residents in the adjoining communities indicated categorically that the noise emanating from the quarries were unbearable, thus creating a nuisance. More so, vibrations resulting from stone blasting with the use of explosives like dynamite were so severe that it results in the sudden shaking of the earth crust. Residents in the communities again mentioned that the persistent vibrations cause shock, fatigue, stress and loss of sleep. One woman at Bepotrim remarked:

*“We can’t sleep in the night because of high level of noise and vibrations. They blast the stones in the night and you have to stay awake till the process is complete.”*

- *Dust Pollution*

From observations made during the field survey, another negative environmental effect associated with quarrying was the excessive emission of dust into the atmosphere, which tends to

affect local air quality. Dust emission into the atmosphere was primarily caused by excavation, drilling, blasting and the crushing of rock products into their respective aggregate sizes. The dust particle in effect does not only affect the quality of local air, but results in serious respiratory disorders like cancer, tuberculosis and silicosis. In terms of dust emissions, the workers at the quarrying sites were the most vulnerable since they had no protective clothing like nose mask to reduce the inhalation of these dust particles.



**Plate 3: Dust Pollution Emanating from Quarrying, Britak Quarry site, Bepotrim**

Source: Field Survey, December, 2014

- *Destruction of Vegetation Cover and Crops*

It was revealed from the field survey that the activity of quarrying is gradually resulting in the destruction of the vegetation cover as well as destruction to crops. This destruction is caused primarily by excavation works that involves the removal of plants and vegetation to expose the burden rock for subsequent exploitation by the quarrying companies. The blasting process also results in the emission of excessive dust that with serious repercussion on food crops cultivated in the area. It was evident from the survey that several crops cultivated were stunted in growth as a result of the quarrying. Thus, when dust particles settle on the plants, it affects the ability of the crops to manufacture their own food, through the natural process of photosynthesis. The gradual and uncontrolled rate of vegetation destruction is leading to deforestation, hence resulting in desertification.





**Plate 4: Stunted Plant Growth as a Result of Sustained Dust Pollution, Papaasu, Bepotrim**

Source: Field Survey, December, 2014

- *Accumulation of Water in Abandoned Pits*

Another significant environmental effect posed by the quarrying operation was the accumulation of large amount of water in abandoned pits. It was observed from the survey that several abandoned pits around the quarry sites have gathered large amounts of water, especially in the rainy season. The accumulation of water in these pits could have both positive and negative outcomes. On the positive front, after a quarry is abandoned, the basin or base of the pit serves as a good reservoir for surface water that is trapped. Community residents and stone workers can use this water to undertake domestic household activities and for other industrial purposes. It is however important to subject such water to careful treatment before using them to undertake domestic chores. Also, the accumulation of water in the abandoned pits can be tapped on to facilitate local agriculture production. Thus water accumulated in the pits can be exploited and used to irrigate crops in the catchment area to enhance all year farming, thus improving food security and stability in the region.

Conversely, the accumulated water in the abandoned pits can also have negative outcomes. Thus, water accumulated in the pits can serve as breeding grounds for mosquitoes. This essentially results in an increase in the prevalence of diseases like malaria and fever. Also the water contained in the abandoned pits can trap community residents and stone workers, which can result in the loss of lives.



**Plate 5: Water Confined in Abandoned Pits, Vision Quarry site, Abrefakrom**

Source: Field Work, December, 2014

- *Destruction of Habitat*

With regards to habitat destruction, the field survey revealed that several damages had been done to the ecology and nature. It was obvious from the survey that the removal of vegetation and cover crops has made animals migrate out of the quarrying sites. Several animal species like grass cutters and rats had left the area as a result of acute shortage of food for survival.

Again dust in the atmosphere from the various activities of quarrying had also slowed down the growth of some plant species in the adjoining arable lands. Several plant species had been rendered stunted in growth as a result of too much dust emission into the atmosphere. Furthermore, noise and vibrations from blasting, operation of machines and transportation have driven away small animals, birds and other wild animals from the nearby forests. The topography

and the state of the environment had also changed due to digging of open pits and the dumping of overburden weathered rock mass in the form of large heaps.

- *Water Quality*

The survey also revealed that the activities of quarrying have altered the quality of local water usually obtained from streams, rivers and springs. From the survey, it was obvious that the blasting of rocks causes waves and vibrations and further loosens the clay particles from the cavities of the river bed, resulting in muddying of the ground water. This makes the water unfit and unsafe for consumption. The consumption of such muddy water may have several associated health hazards.

- *Flying Rocks*

Another negative environmental effect associated with quarrying that was identified in the research was the destructions caused by flying rocks. The presence of flying rocks emanated primarily from the blasting of rock products using powerful explosives like dynamite. Flying rocks had caused various degrees of damages; notable among them is the perforation of roofs. This phenomenon has the potential of increasing complaints from adjoining or nearby landowners, raising the levels of community conflicts and litigation. The Odikro for Paapasu remarked that:

*“My brother we sleep with fear because of flying rocks and during blasting in the night and your roof will be perforated by flying rocks causing injury to and your family. We want them to relocate us so that our families will be safe”.*

It was however revealed from this research that households were very much concerned and worried about the environmental effects associated with the activity, particularly, the sustained dust and noise pollution. This phenomenon had caused to sleepless nights and several respiratory disorders. It is therefore incumbent on the quarrying companies to put in place remedial measures to ameliorate the potential effects of the activity.

#### 4.5.2 Socio-cultural effects

Having looked at the detrimental environmental effects posed by quarrying, it is imperative that the research goes ahead to critically assess the socio-cultural effects the activity comes along with. The socio-cultural effects of quarrying that were identified from the field survey are elaborated in the following paragraphs.

- *Support in the Provision of Social Amenities and Infrastructure*

The field survey brought to light that one significant social benefit resulting from quarry operations is support in the efficient construction and delivery of important social amenities and infrastructure. Thus, communities in the municipality heavily relied on the stone products from the sites to undertake the construction of several facilities like schools, clinics, boreholes and market stalls. The proximity of the communities to the quarry sites presents a potential that facilitates the rapid construction of some essential facilities and infrastructure. In effect, the provision of all these facilities and amenities ultimately results in an improvement in the welfare and wellbeing of the society to a larger extent.

- *Development of Cracks in Buildings*

It was also observed that several magnitudes of cracks, with some near collapse were found in buildings in the surrounding communities. The main source of the deep cracks in buildings was as a result of the persistent and frequent use of explosives in blasting the large masses of rocks. From the household interviews administered, majority, (51%) of the households indicated that one of the negative outcome associated with the quarrying activity is the creation and the further deepening of cracks in their buildings, which are constructed with poor quality building materials. The households, however, indicated that the sustained deepening of cracks primarily caused by rock blasting lead to the collapse of their buildings, and sometimes resulting in the loss of lives and properties.





**Plate 6: Series of Cracks in Buildings Resulting from Quarrying, Buoku and Papaasu**

Source: Field Survey, December, 2014

- *Supply of Quarry Products to Communities to Undertake Self Help Projects*

The field survey further revealed that, all quarrying companies at the request of the host communities, the Municipal Assembly, Traditional Authorities and Assembly members freely supply quarry products towards community development initiatives. Development projects that have been initiated in the communities were supplied with rock and other quarry products as part of the corporate social responsibility of the companies. From 2010 to 2014 total value of quarry products supplied to communities, the Traditional Authorities, Assembly member and the Assembly is estimated at GH¢70,952.00. This amount would have been provided by the Assembly to construct or remedy the problems the communities were facing. This phenomenon, however, reduces the cost incurred in project implementation, hence channeling the remaining financial resources into addressing other community needs. Table 4.4 shows some of the projects the quarry companies have supported with quarry products and their estimated cost.

**Table 4.4 Projects supplied with free Quarry Products and Estimated Cost**

S/No.	Project	Beneficiary Community	Quantity of product supplied	Estimated Cost	Year
1.	Rehabilitation of Old Cocoa Shed for Community Senior Secondary School	Buoku	40m <sup>3</sup>	<b>2,240.00</b>	2014
2.	Construction of Wenchi Traditional Council Office	Wenchi	120m <sup>3</sup>	<b>6,720.00</b>	2011
3.	Construction of Community centre	Wenchi	200m <sup>3</sup>	<b>11,200.00</b>	2012
4.	Supply of Boulders to check erosion	Kaamu	21m <sup>3</sup>	<b>1,176.00</b>	2013
5.	Construction of Polytank Stand	Nkonsia	14m <sup>3</sup>	<b>784.00</b>	2014
6.	Supply of 0/40 quarry products for the New Market	Wenchi, New market	720m <sup>3</sup>	<b>40,320.00</b>	2014
7.	Supply of quarry products for patching of pothole of Wenchi Towns roads	Wenchi	20m <sup>3</sup>	<b>1,120.00</b>	2012
8.	Construction of 2-unit Nursery block	Abrefakrom	12m <sup>3</sup>	<b>672.00</b>	2011
9.	Supply of 25mm quarry product to Divisional Police Headquarters	Wenchi	120m <sup>3</sup>	<b>6,720.00</b>	2012
	<b>Total</b>			<b>70,952.00</b>	

Source: Extracted from reports of Quarrying Companies, 2014

- *Corporate Social Responsibility*

More so, it was evident from the survey that the quarrying companies are rigorously pursuing their corporate social responsibilities to the various communities as a form of compensation for the negative effects of their activities on the various facets of the society as indicated in Table 4.5. The provision of these services and amenities by the companies essentially reduces the huge burden on the Municipal Assembly in providing the needed amenities desired and required to make life worth living. The Municipal Assembly also confirmed that the quarrying companies offer varied levels of financial support in organizing programmes like “my first day at school”.



“Farmers day” and “national immunization day programmes”. For instance, the mentioned that for the year 2014 a total of Twenty-six thousand five hundred and six Ghana cedis (GH¢ 26,506.00) was received from the quarry companies as support towards the implementation of the above mentioned programmes.

**Table 4.5 Corporate Social Responsibilities of Quarrying Companies**

<b>S/No.</b>	<b>Activity</b>	<b>Beneficiary Communities</b>	<b>Company</b>
1.	Construction of 2No Boreholes fitted with hand pumps	Nkonsia Buoku	Vision Quarry Britak Quarry Products
2.	Clearing of site for the construction of a community market	Buoku ,Tromeso Ayaayo	Nsemere Taysec
3.	Donation of 115 Bags of cement and 15 packets roofing sheets for construction and maintenance of community projects	Nkonsia, Buoku Paapasu, Bepotrim, Abrefakrom	Britak, J.A. Quarry, Stardust
4.	Registration of 361 community members on the National Health Insurance Scheme	Ayaayo, Nkonsia, Bepotrim, Paapasu, Abrefakrom, Buoku, Tromeso, Kookosu	J.A. Quarry, Britak, Vision, Nsemere Quarry
5.	Provision of Essential commodities (Milk, Rice, oil, Soap)	Paapasu, Buoku, Bepotrim, Abrefakrom	J.A. Quarry, Britak, Vision

Source: Field Survey, December, 2014.

- *Productive and Physical Capital*

Another prominent social benefit obtained from the activity was the provision of productive and physical assets. The increase in monetary income is important in satisfying a wide range of material needs and acquisition of assets. Incomes earned from the activity had enhanced the well-being in terms of health, education and general contentment of workers. The quarry workers

are able to provide for the basic needs of their households and invest in assets such as; land, livestock, houses and retail business. These assets provide them with additional income hence reducing their vulnerability to economic shocks at the quarry. From their earnings the workers enhance their physical capital by constructing houses either for residential or commercial purposes. Out the 90 households interviewed, 6 percent indicated that they have been able to acquire or building theirs houses, land from the earnings from the quarry companies.

- *Absence of Protective Clothing*

Another imminent social problem identified from the field survey was the absence of protective clothing. That is the stone workers, in spite of the hazardous nature of their activity had no protective clothing like hand gloves, nose masks, safety boots and goggles to put on during their operations. This in effect makes them susceptible to accidents and injuries resulting from the rock blasting. Due to the hazardous nature of quarrying activity, all range of workers at the site needs to be provided with safety devices or protective clothing to minimize or halt the occurrence of accidents. Through the survey, some of the workers hinted on several fatal accidents like burns, cuts, injuries and falls that had occurred as accidents at the site.

Surprisingly, only 17% of the workers had adequate protective clothing whilst at work. This phenomenon poses a greater risk to the other workers who do not have protective clothing. The survey further brought to light that, the workers without these protective clothing had officially made a complaint to the top management of the companies to endeavor to provide these basic items.

This research also revealed that there was a link or connection between the prevalence of respiratory disorders and the activities of quarrying. Available data from the Municipal Health Directorate indicated that the fourth most common diseases in the Municipality are diseases like lung cancer and silicosis, all borne out of the operations of quarrying. These diseases were however prevalent in areas where quarrying was a predominant activity undertaken.

#### **4.5.3 Economic effects of quarrying**

It became obvious from the field survey that, the quarrying activity has numerous economic effects on the municipality. Some of the economic effects of the activity identified from the survey are presented below:

- *Employment and Wages*

The stone quarrying industry generates substantial employment opportunities to inhabitants in the municipality. Also, several people outside the municipality have been offered employment in the quarrying companies. Workers ranging from drivers, mechanics, welders, filed operators; marketing managers and financial accountants were all engaged in quarrying and are guaranteed secure tenure or stability of employment as indicated in Table 4.6. The workers subsequently earn incomes from their contribution to production and cater for the numerous needs of their dependents from such incomes and wages earned from the activity. Data collected from the quarries revealed that about 145 persons are employed by all the quarry companies operating in the municipality and as such earn wages.

- *Source of income for livelihood*

The activity serves as the main source of income for livelihood of the employees. The workers solely rely on their income to provide for themselves basic needs such as food, clothing and shelter. The workers also made it known that; they are now capable of meeting the health and educational needs of their households as they are empowered financially by their engagement in the quarrying activity. The income earned from the activity has a multiplier effect on the local economy. That is, increment in the income levels of stone workers; increases their purchasing power for goods and services, hence, making the local economy richer through the series of re-spending.

**Table 4.6 Fields of Employment by Quarrying Companies**

S/No	COMPANY	NO. EMPLOYED	CATEGORY OF WORK AND DISTRIBUTION	
1	BRITAK	28	Security	5
			Mechanics	6
			Drivers	6
			Cleaners	3
			Sales works	4
			Field operators	4
2	NSEMERE	23	Security	4
			Mechanics	5
			Drivers	4
			Cleaners	3
			Sales works	3
			Field operators	4
3	J.A QUARRY	39	Security	6
			Mechanics	7
			Drivers	9
			Cleaners	5
			Sales works	8
			Field operators	4
4	VISION	23	Security	4
			Mechanics	4
			Drivers	5
			Cleaners	3
			Sales works	4
			Field operators	3
5	STARDUST	19	Security	3
			Mechanics	3
			Drivers	4
			Cleaners	2
			Sales works	3
			Field operators	4
6	TAYSEC	13	Security	2
			Mechanics	2
			Drivers	3
			Cleaners	2
			Sales works	2
			Field operators	2
Total				144

Source: Field Survey, December 2014

- *Payment of taxes and royalties to the Assembly and the stool lands respectively*

Another crucial effect of the stone quarrying was found to be the payment of taxes and royalties to the Assembly and the stool lands respectively. The presence of the quarrying companies have boosted the revenue generation of the Assembly as they make an average annual payment of GH¢ 6,000.00 as property rate. The amounts paid as property rates are not fixed since the Municipal Assembly from time to time reviews the operational and property rates. The amount received is used by the Assembly to undertake developmental initiatives. An interview with a representative of the Traditional Authorities also brought to light that the authority uses the royalties received from the companies to complement the developmental efforts of the Assembly and the government at large. From the questionnaire administered it was revealed that, royalties from the quarries were being used for, servicing of traditional council meeting, travelling and transport for Nananom to attend functions and offering sacrifices to gods. The construction of the Traditional Council Office which is about 40% completed and rehabilitation of the old traditional council block were also mentioned as been funded from royalties. Table 4.5 shows the amount of property rates and royalties that are paid to the Municipal Assembly and Traditional Authorities respectively.

**Table 4.7: Payments made by Quarrying Companies to the Municipal Assembly and Traditional Authorities for the 2014 Financial Year.**

S/No	COMPANY	PAYMENTS TO MUNICIPAL ASSEMBLY (GH¢)	PAYMENTS TO TRADITIONAL AUTHORITIES (GH¢)
1	BRITAK	6,147.10	3,643.20
2	VISION	4,987.41	3,987.00
3	J.A QUARRY	6,457.14	3,741.31
4	NSEMERE	5,457.00	2,654.22
5	STARDUST	5,900.00	3,100.00

Source: Extracted from the reports of Quarrying Companies, December, 2014 and Final Account, Wenchi Municipal Assembly, December, 2014

- *Cost of subprojects in the Municipality low due to the availability of quarrying companies*

Data collected from the Works Department of the Wenchi municipal Assembly revealed that the presence of the quarrying companies has also kept the cost of subprojects in the Municipality is low as compared to the cost of similar subprojects in other Districts and Municipalities in the Brong Ahafo Region. For instance, under the Urban Development Grant, the cost of constructing a three-unit classroom block with ancillary facilities awarded on March, 2014 was GH¢114,399.00 in the Wenchi Municipality which is comparatively lower than other sister Districts like Techiman Municipality where the same subproject cost GH¢140,000.00, whilst that of Asunafo North District cost GH¢147,000.00. The lower cost of subprojects in the Wenchi Municipality is heavily due to the proximity of the building materials produced by the quarrying companies, which brings down the transportation cost thereby resulting savings for the Assembly.

#### **4.6 Extenuation Measures**

In view of, the effects of the processes of quarrying, the quarrying companies have been embarking on some extenuation measures to minimize the nuisance and negative effects associated with activity. The extenuation measures are the various activities that are put in place to remedy or prevent the negative effects of an undertaken from occurring. Some of the measures found during the field survey are elaborated below.

- *Noise Emission Standards*

A practical measure being put in place by the quarrying companies to minimize the noise and nuisance emanating from the activity is a strict compliance with the noise emission standard issued by the Environmental Protection Agency. The Environmental Protection Agency guide in respect of quarrying activities stipulates that the noise levels permitted under law by the companies must not exceed 55 decibels and 48 decibels during the day and night respectively. The field survey, however, revealed that the quarrying companies are adhering strictly to this directive from the Environmental Protection Agency. The compliance with policy has potentially minimized the noise levels that are associated with quarrying.

- *Timing Restrictions on Operations*

Another extenuation measure being undertaken by the quarrying companies is the imposition of time restrictions on their operations, with specific emphasis on blasting and crushing. The time restrictions imposed on the various activities appear to be a very appropriate extenuation measure in reducing the adverse effects of the activity on the environment and inhabitants residing in the catchment area. The time permitted for blasting and crushing activities ranges between 10:00 and 16:00 hours, Monday to Saturday, except where blasting is necessary for safety reasons. Thus, quarrying companies are required to do their blasting and crushing within a restricted period of time to help neighbor's deal with the excessive noise and dust resulting from quarrying. These timing restrictions of activities are provided, regulated and monitored by the Environmental Protection Agency.

- *Alarms, Warning Signals and Road Blocks*

This extenuation measure being implemented by the companies is designed to essentially create the awareness of residents in the adjoining communities on the time periods in which blasting, crushing and drilling usually take place. The structured interview scheduled with the personnel at the companies revealed that loud alarms are usually sounded prior to the initiation of any blasting activity. Residents upon hearing the loud sounds from the alarms are expected to move further away from where the blasting activities are taking place. Also, warning signals are erected along roads, tracks and access routes to make residents privy to the various points where blasting are likely to take place. The companies are, however, not responsible or liable for any damages and injuries caused to residents who get injured when all such warning signals are issued. Lastly, vehicles plying along the quarry roads are all blocked when blasting activities are being carried out. This is essential to reduce or minimize the incidence of flying rocks causing damages to vehicles during the operations of the companies.



**Plate 7 Warning Signal Erected Along a Blasting Zone, Vision Quarry site, Abrefakrom**

Source: Field Survey, 2014

- *Water Spraying*

Also, as a measure to minimize the dust levels emanating from the processes of quarrying, the companies do resort to water spraying. The quarrying companies use large water trucks in spraying the dust around the quarry sites, and more particularly, applied on the rocks right after blasting. This is necessary to minimize or suppress the dust levels that are generated during blasting, crushing and transportation of rock products. This practice essentially minimize the dust levels produced during operations and further reduces the incidence of contracting respiratory disorders like tuberculosis and cancer.

- *Educating Inhabitants not to Drink Rain Water.*

More so, as a preventive health care measure, the residents in the neighbouring communities are exposed to an intensive public education that discourages them from consuming rain water. The activities of quarrying result in the discharge of harmful chemicals like silica in the atmosphere



which mixes with rain water, hence making it unfit for human consumption. The companies, as a measure to compensate the communities for the pollution of rain water have made provisions for potable water sources like boreholes and stand-pipes in the adjoining communities. This education is usually facilitated by the Municipal Assembly, the Environmental Protection Agency or the Companies.

- *Provision of Protective Clothing*

Lastly, another important measure being adopted by the quarrying companies to minimize the potential effects of quarrying on the stone workers is the provision of safety and protective clothing. The management of the companies make provisions for safety devices like helmet, goggles, nose mask and aprons. The provision and use of all these materials insulates the workers from some respiratory disorders like cancer and silicosis, as a result of too much exposure to dust particles. Also, the management of the companies as a preventive health measure do provide food supplies like milo, milk and periodically organize medical checks to improve upon the health status of the workers.

## **CHAPTER FIVE**

### **SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION**

#### **5.1 Introduction**

Following from the analysis and discussion of the survey data in the preceding chapter, this chapter summarizes the major findings from this research. The numerous challenges identified in the research serve as a basis for recommendations to be made for this research.

#### **5.2 Major Research Findings**

A host of issues were identified in the research. This section discusses the key findings from this research.

- The survey revealed that 70% of the inhabitants or households interviewed in the quarrying communities have attained some form of education. Most of them have attained only basic education, with a minimal proportion having attained secondary or higher levels of formal education.
- It was further established from the survey that agricultural activities remain the dominant source of employment for the residents in the communities, employing about 81 percent of the households interviewed, in spite of the growth and boom in the quarrying industry. Only 4.2 percent of the inhabitants in the community were engaged in quarrying. This reinforces the point that the mainstay of rural communities is agricultural.
- It was revealed from the field survey that the income levels of the people living in the communities around the quarrying companies were generally low. Most of the respondents interviewed at the quarrying communities were found to be in the low income bracket group. The few people earning above GH¢ 300.00 were mostly salary workers whereas the farmers were found to be the least earners in the areas with most of them earning GH¢ 100-200 monthly.
- With regards to tools and devices used in undertaking processes of quarrying, both simple and sophisticated devices were identified from the research. The use of large and sophisticated devices makes production and productivity more effective and efficient; hence it is massively adopted by the quarrying companies. Some examples of such

sophisticated devices among others include; extension rods, button bitch, mobile ridges, crushers, excavators, explosives, pull loaders and bulldozers.

- Several effects, with some being positive and others being detrimental to the environment and human health were established from the research. With regards to environmental effects associated with the activity, the survey revealed negative environmental consequences such as land degradation and loss of top soil, noise pollution and vibration, dust pollution, destruction of vegetation, destruction of habitat and reduction in water quality all emanating from quarrying. The only positive environmental effects associated with quarrying on the environment was the accumulation of water in the abandoned pits which could be capitalized on for irrigation purposes to enhance all year round farming.
- On the socio-cultural front, several effects were also identified. It was established that several social corporate responsibility projects have been undertaken by the companies operating in the municipality. The corporate responsibility projects undertaken by the companies are attempts to compensate residents in the adjoining communities on the numerous environmental challenges resulting from quarrying.
- With respect to economic effects, benefits such as creation of employment, source of income and payment of taxes and royalties to the Municipal Assembly and the Traditional Authorities respectively accrue from quarrying.
- It was revealed from this research that there is a lack of effective enforcement and supervision of the activities of quarrying. Some of the environmental and regulatory guidelines contained in the various laws and acts are not strictly being adhered to. Regulatory bodies like the Environmental Protection Agency and the Municipal Assembly were not doing enough to ensure strict adherence to the provisions and regulations spelt out in the acts.
- It was evident from the survey that the quarrying companies have put in place several measures to minimize the negative consequences associated with their operations. Some of the extenuation measures among others included: compliance with noise emission standards, timing restrictions of operations, warning signals, alarms, road blocks, water spraying and an intensive public education are all measures currently being implemented by the companies to minimize the negative outcome of their operations.

### 5.3 Recommendations

Several issues have been brought to light by the research. This section of the report further recommends certain measures to minimize the potential effects of quarrying and to enhance a more sustainable approach to extracting the rock products.

- *Occupational Safety and Sensitization Programmes*

The field data revealed that worker's safety at work was not guaranteed due to the absence of safety and protective clothing. This phenomenon exposes workers to serious occupational hazards and injuries during operation. As far as practical, management of the companies must make conscious efforts to make available safety devices and clothing like goggles, safety boots, helmets and nose masks. The provision of all these clothing will enhance worker's safety at work, hence reducing and/or preventing potentially fatal accidents occurring at the site. Also, workers must be sensitized on safety measures and practices they can adopt to avert the occurrence of some preventable accidents and diseases. An occupational safety expert must be regularly consulted to brief workers on safety practices and measures to adopt at the work place.

- *Medical Checkups and Screening for Workers*

As a preventive and curative health care measure, regular and routine medical checkups should be conducted for workers. This will update them on the extent of damage the excessive dust inhalation has caused them. This awareness creation will help them put in place prudent medical measures to cure or relieve them of the adverse effects of their illness. This in essence will improve worker's health status hence an improvement in workers' productivity.

- *Watering Trucks, Sweepers and Chemical Application to minimize Dust Pollution.*

Also, to minimize the excessive dust emission and inhalation by workers and inhabitants in the surrounding communities, facilities like water trucks, sweepers and some chemicals that help minimize or mitigate the emission of dust particles must be applied before operation commences. The application of this dust reduction measures will help reduce the amount of dust emitted during processes of quarrying. This will significantly reduce the contraction of respiratory disorders like silicosis, tuberculosis and lung cancer.

- *Reclamation/Covering of Pits*

A negative environmental effect associated with quarrying is the destruction of the environment resulting from the large pits quarrying creates which usually are not covered. These large pits could trap workers and may serve as breeding grounds for mosquitoes and also pose a threat to human security. This research therefore calls for the need for best environmental practices through the reclamation of the large dug out pits. That is the abandoned pits must be covered with soil. The reclamation of the large pits is a way of putting the unproductive large pits into productive use in the future.

- *Environmental Awareness*

Workers and various stakeholders in the quarrying industry must be made aware of the extent of damage the activity leaves on the environment. This awareness creation could be best facilitated under the supervision of the Environmental Protection Agency. This awareness will help stakeholders adopt best environmental practices which will go a long way to minimize the potentially negative effect of quarrying on the environment. Although, it appears that most stakeholders are aware of the negative environmental consequences of quarrying, but the awareness creation has to be deepened to enhance practical measures of preserving the environment and ecology.

- *Enforcement of existing laws on quarry*

There must also be a strict enforcement of the existing mining and environmental laws to ensure a significant reduction in the incidence of environmental problems associated with quarrying. Laws and regulations like timely restrictions of quarrying activities and erection of signals along blasting sites must be strictly enforced. Regulatory bodies like the Environmental Protection Agency and the Municipal Assembly must undertake frequent and regular field checks and monitoring to ensure compliance with the numerous laws provided to enhance the sustainability of the environment.

#### **5.4 Conclusion**

Stone quarrying as an environmental activity enhances the growth of other livelihoods both in the community and in the stone workers' livelihoods. Because such activities are fast profit yielding, they can be used as a basis to enhance rural development, since they promote infrastructural development. In order to ensure sustainable development, there is need to recognize economic activities such as stone quarrying by policy makers and NGOs. This is in relation to reducing the effects of quarrying on the livelihoods of the inhabitants of the host communities as well as those engaged in them. In the same way, environmental sustainability should be given a high priority in an effort to preserve finite resources for the future generations. There is need to ensure that processes of quarrying are conducted in such a way that the larger scale benefits to society are explicitly acknowledged and that strenuous efforts are made to make sure that these benefits can be sustained even when quarrying activities have stopped.

## REFERENCES

- Adams, W. M. (2001), *Green Development Environment in the Third World*. Routledge Group, London.
- Adelman I., Fetin, H. and Golan, E. H. (1997), Development strategies and environment, *The Environment and Emerging Development Issues*, 1 (1) 11-20.
- Agbesinyale P, Tenkorang E.Y. and Dankwa M., 2012, *Extractive Industries, the State and Host Communities: A Case Study of Gold Mining in Ghana*, Marcel Hughes, Cape Coast, Ghana.
- Akabzaa, T. & Darimani, A. (2001). Impacts of Mining Sector investment in Ghana: A Study of the Tarkwa Mining Region, Accra. [http://www.saprin.org/ghana/research/gha\\_mining.pdf](http://www.saprin.org/ghana/research/gha_mining.pdf). Accessed on 23/10/2013.
- Akabzaa, T. (2004), African mining codes a race to the bottom, *Third World Network Features: African Agenda*, 7(3), 62-73.
- Areola, O. (1991). *Ecology of Natural Resources in Nigeria*. Avebury Academic Publishing Group, Aldershot, England.
- Ambrose-Oji B. (2009), Livelihood Impacts of quarrying and Restoration of Quarry sites in Kota and Bundi Districts of Rajasthan, India. <http://www.researchgate.net/publication/228450719>. Retrieved on 5th November, 2014
- Anafo, D. (2013). Systems approach to pro-poor land reforms: a concept paper. *Land Use Policy*, 35(42), 421-426.
- Auty, R. (1995). *Sustaining in the Mineral Economies: the resource curse thesis*, Routledge, London
- Baird C, (1992). *Environmental Chemistry*, 2nd Edition, W. H. Freeman and Company, New York
- Banez J., Ajaon S Mae, Bilolo J.R. and Dailyn J. M., (2010) *Quarrying and Its Environmental Effects*: <http://www.scribd.com>. Retrieved on October 14, 2014.
- Brandon, K. E. and Brandon, C., (1992), Introduction: World Development; *Special Issue: Linking Environment to Development: Problems and Possibilities*, 2, (4) 477-479.

Bushran, C., Asian Mining, (2008), Solutions for Development and Expansion, Proceedings of Second Asian Mining Congress, Kolkata, India

Campbell, B. (2004). Negotiating the bauxite/aluminium sector under narrowing constraints, *Review of African Political Economy*, 51, 27–49

Candessus, M. (2001). Nigeria, Unlocking the future. *Business Confidential: Nigeria's Business Newsletter*. 27 (35), 3.

Cheru, F.( 1992). Structural Adjustment, Primary Resource Trade and Sustainable Development in Sub-Saharan Africa. *World Development* 20(4) pp. 497-512.

Commission for Africa (2005). “*Our Common Interest*”: *Report of the Commission for Africa*, London: Commission for Africa:

Commission on Sustainable Development. (2008). Review of implementation on land: Report of the Secretary-General to the United Nations Economic and Social Council (Vol. E/CN.17/2008/5): Commission on Sustainable Development.

Cooter, R. (1982). The cost of Coase. *Journal of Legal Studies*, 11(1), 1-33.

Cowell R. (2000), Environmental Compensation and the Mediation of Environmental Changes, Making Capital out of Cardiff Bay, *Journal of Environmental Planning and Management*, 9 (2), 12-24.

Davy, B.,(2009). The poor and the land: poverty, property and planning, tpr 80, Liverpool University Press, 4 Cambridge Street, Liverpool L69 7ZU.

Deborah, S. (1996). “Breathtaking: premature Mortality due to Particulate air pollution in America Cities” Natural Resources Defence Council: New York. Pp 14 – 15.

Demsetz, H., 1967. Toward a theory of property rights. *The American Economic Review* 57 (2), 347–359.

De Soto, H., 2000. The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else. Bantam Press, London.

Delbridge, T. & Lowe, M. (1998). Digging to Development? A historical look at mining and economic development, Boston, MA: Oxfam America.



Department of Agriculture, (2013), Annual Progress Report 2013, Government of Ghana, Wenchi

Department of the Environment, Heritage and Local Government, (2004), Quarries and Ancillary Activities -Guidelines for Planning Authorities. <http://www.environ.ie/en/Publications/DevelopmentandHousing/Planning/FileDownload,1606,en.pdf>. Accessed on 23/10/2013

Dreschler, B. (2001) Small scale mining and sustainable Development within the SADC Region. MMSD Research Topic 1. <http://www.iisd.org/natres/mining/#edn2> Accessed on 23/11/2014

Dolšák, N., & Ostrom, E. (Eds.). (2003). The Commons in the New Millennium: Challenges and Adaptations. Cambridge, Massachusetts and London: The MIT Press.

Enger, E.D and Smith, B.F (2002). Environmental Science: A study of Interrelationship (8th edition) McGraw-Hill Higher Education, New York Pp372 -377.

European Commission (2000). Managing Natural 2000 Sites, The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Luxembourg, Office for Official Publications of the European Communities.

Finnish Institute of Occupational Health (2002). Child Labour in Sandstone Mines, ILAB Report, 2003.

Ghai, D. (1994) Environment, Livelihood and Empowerment: *Development and Change* (25) 1-11, Blackwell Publishers, 108 Cowley Rd Oxford OX4 1JF, UK.

Ghana Statistical Service (2014), 2010 Population and Housing census, District Analytical Report, Wenchi District, Publication and Sales Unit, Accra, Ghana.

Gunn, John, and Bailey, Debra (1993). Limestone quarrying and quarry reclamation in Britain: *Environmental Geology*, 21, 167 – 172.

Gunn, John, Bailey, Debra, and Handley, John, (1997), The reclamation of limestone quarries using landform replication: Department of Geographical &Environmental Sciences, University of Huddersfield, Queensgate, Huddersfield,U.K., 176 p.

Government of Ghana (1993). Mining and Minerals Act, 1993, Act 450, Ministry of Lands, Forestry and Mines. Assembly Press, Accra.

Government of Ghana (2006). Mining and Minerals Act, 2006, Act 703, Ministry of Lands, Forestry and Mines. Assembly Press, Accra.

Hawthorne, J. (1990). Mining Royalties: A global study of their impact on investors, government, and civil society, *Directions in Development, Energy and Mining*, Washington D.C.: World Bank Publications.

Hardin, G. (1968). The Tragedy of the Commons, *Science*, 162(3859), 1243-1248.

Health Effects Institute – HEI (1995). Particulate Air Pollution and Daily Mortality: Replication and Validation of selected studies, HEI Cambridge, MA. P 4.

Hilson, G. (2002) Small-scale mining and its socio-economic impact in developing countries, *Natural Resources Forum* 26 (1), 3 – 13.

Hunt, D (1989). *Economic Theories of Development*, Harvester Wheatshead: London.

Kendie S. B. and Martens P. (2008). *Governance and Sustainable Development*, Marcel Hughes Publicity Group, Cape Coast, Ghana

Kendie S. B. (2011). Re-Claiming Development: Appreciating the basics for Effective Local Level Development in Ghana, Inaugural Lecture presented to the University of Cape Coast, Cape Coast, Ghana.

Kuiper, G. (1997), Compensations of Environmental Degradation by Highways: A Dutch Case Study, *European Environment*, 7:118-125.

Kumar, R. (1999). *Research methodology. A step-by-step Guide for beginners*, London: Sage Publications.

Langer, W. H., (2001), Potential Environmental Impacts of Quarrying Stone in Karst, <http://geology.cr.usgs.gov/pub/ofrs/OFR-01-0484/>, page 10, Accessed on 23/10/2013.

Last, J.M. (1998). *Public Health and Human Ecology* (2nd Edition), McGraw-Hill Medical Publishing Prentice-Hall Int. Edition Canada. Pp153-200.

Long, Chun-Lin, Jefferson Fox, Lu Xing, G. L., Cai Kui, & Wang Jieru. (1999). State Policies, Markets, Land Use Practices and Common Property: Fifty Years of Change in a Yunnan Village, *China Mountain Research and Development*, 19(2), 133-139.

Madhavan P & Raj (2005) Budhpura Ground Zero: Sandstone Quarrying in India. [www.indianet.nl/budhpura.html](http://www.indianet.nl/budhpura.html) 15/11/2014.

Martyn, S. (Sep 14, 2008). Qualitative Research Design. Retrieved Oct 09, 2014 from Explorable.com: <https://explorable.com/qualitative-research-design>.

Meadows, D.H., Meadows, D.L., Randers, J. and Behrens III, W.W. (1972), The Limits to Growth: a Report for the Club of Rome's Project on the Predicament of Mankind. New York: Universe Books.

Minerals Commission, (2001). Ghana Mining Sector Development and Environment Project, Ghana Mineral Commission, Government of Ghana ,Accra

Mines, Minerals and People (MM&P), (2003) Reports of National Seminar on Women and Mining in India, New Delhi.

Montgomery W.C. (1992). Environmental Geology, 3rd Edition, Wm C. Brown Publishers, Dubuque.

National Industrial Sand Association (1997), Respiratory Health Effects of Crystalline Silica: As available at [www.riccisand.com/health](http://www.riccisand.com/health). Retrieved on Oct, 14, 2014

Nartey V. K., Nei-Nanor J, Klake K. R. (2012). Effects of Quarry Activities on some selected Communities in the Lower Manya Krobo District of the Eastern Region of Ghana: <http://dx.doi.org/10.4236/acs.2012.23032>, Retrieved on October 14, 2014

Owusu-Koranteng, H. (2005) Surface Mining and Community Livelihood: The Case of Teberebie Electoral Area of Wasssa West District: Unpublished MA Dissertation Submitted to the Center for Development Studies, University of Cape Coast.

Ostrom, E., Dietz, T., Dolšák, N., Stern, P. C., Stonich, S., & Weber, E. U. (2002). The drama of the commons: National Academies Press.

Ostrom, E. (1990). Governing the commons: The evolution of institutions for collective action: Cambridge University press.

Priyadarshi N. (1998). Social and Gender Issues in the Stone Quarries Around Ranchi city, Jharkhand, India. <http://asmasiapacific.org/wp-content/uploads/2014/07/Priyadarshi200-SocialGenderIs.pdf>. Retrieved on 5th November, 2014

Potter, R. B., Binns T., Elliot, J. A. and Smith, D. (1999) Geographies of Development London: Longman.

- Redmond, H. (2005). *From Adjustment to Development in Africa*, London: Macmillan.
- Rees, W. (1999). Achieving sustainability: Reform or Transformation? in D. Satterthwaite (ed.), *The Earthscan Reader in Sustainable Cities*, Earthscan Publications Ltd, London.
- Repley, J. (1996) *Understanding Development: Theory and Practice in the Third World*, UCL Press: London
- Rundcrantz, K and Skarback, E. (2003). Environmental Compensation in Planning: A Review of Five Different Countries with Major Emphasis on the German System', *European Environment*, 13:204-226
- Seers, D. (1969) 'The Meaning of Development', *International Development Review* 11, 2–6.  
Web of Science® Times Cited: 39
- Songsore, J., Yankson, J. & Tsikata, G. (1994). *Mining and the environment – towards in-Win Strategy: A study of the Tarkwa-Abosso-Nsuta mining complex*, Legon: University of Ghana.
- Strauss, A. and Corbin, J. (1990). *Basics of Qualitative Research. Grounded theory, procedure and techniques*, Newbury Park, C.A: Sage Publications INC
- Todaro P. Michael, and Smith C. Stephen (2009), *Economic Development*, Tenth Edition, Pearson Education Limited, Edinburg Gate Harlow, England
- Taylor, L. (1996). Sustainable Development: An Introduction, *World Development Special Issue on Sustainable Development*, 24 (2) 215-225.
- The World Bank (2013). *Growing Africa: Unlocking the Potential of Agribusiness*. <http://siteresources.worldbank.org/INTAFRICA/Resources/africa-agribusiness-report-2013.pdf>  
Retrieved December 5, 2013
- The World Bank. (2002). *Building Institutions for Markets*. New York: Oxford University Press.
- Treweek, J. (1999). *Ecological Impact Assessment*, Blackwell Science, Oxford.
- UNEP, (2013). *Embedding the Environment in Sustainable Development Goals. UNEP Post-2015 Discussion Paper 1*. United Nations Environment Programme (UNEP), Nairobi
- UNEP (1991b). *Urban air Pollution.: Environment Library*, No. 4, Nairobi: UNEP.

UN Habitat, & Global Land Tools Network (Eds.). (2008). *Secure Land Rights for All*. Nairobi, Kenya: UN Habitat.

Ursic, K.A., Kenkel, N.C., and Larson, D.W.(1997), Revegetation dynamics of cliff faces in abandoned limestone quarries: *Journal of Applied Ecology*, 34. 289-303.

Wenchi Municipal Assembly (2006), District Municipal Term Development Plan, 2006-2009, Government of Ghana, Wenchi

Wenchi Municipal Assembly (2010), District Municipal Term Development Plan, 2010-2013, Government of Ghana, Wenchi

Weyzig F. (2006). From Quarry to Graveyard, India Committee of the Netherlands, pg 12. <http://www.eldis.org/go/home%26id%3D23718%26type%3DDocument>. Retrieved on 5<sup>th</sup> November, 2014.

World Bank (2003). Strategy for African mining; *Africa Technical Department Series*, mining unit, industry and Energy Division. Technical Paper No. 181, Washington D. C.: World Bank.

World Commission on Environment and Development (The Brundtland Commission) (1987), “Our Common Future”, Oxford University Press, Oxford, England

Yin, R. K. (1994). *Case Study and Research: Design and Methods*, (2nd Edition) London: Sage Publications INC.

## APPENDIX 1

### **KWAME NKRUMAH UNIVERSITY OF SCIENCE TECHNOLOGY** **COLLEGE OF ARCHITECTURE AND PLANNING** **DEPARTMENT OF PLANNING**

#### **QUESTIONNAIRE FOR HOUSEHOLDS**

This questionnaire is to retrieve information from households residing around the stone quarrying centres to aid the study into “*Assessing the Effects of Stone Quarrying on Wenchi Municipality*”. The information would be used for postgraduate thesis that would be submitted for a partial fulfillment of **Master of Science Development Policy and Planning in KNUST**.

#### **SECTION A: PERSONAL DATA**

1. Name of Respondent.....
2. Age of Respondent.....
3. Sex: **Male** [ ] **Female** [ ]
4. Marital status of Respondent
  - (a) **Married**
  - (b) **Single**
  - (c) **Widow/Widower**
  - d) **Divorced**
5. What’s the highest level of education attained?
  - (a) **Basic**
  - (b) **Secondary/Vocational**
  - (c) **Tertiary**
  - (d) **None**
6. What is your occupation?
  - (a) **Farming**
  - (b) **Quarrying**
  - (c) **Service**
  - (d) **Commerce**
  - (e) **Others, specify.....**

7. How much do you approximately earn in a month?

(a) Less than GHC 100

(b) GHC 100-200

(b) (c) GHC 201- 300

d) Above 300

8. How long have you lived in this community?

(a) Less than a year

(b) 1-5 years

(b) (c) 5-10 years

(d) More than 10 years

9. Is any member of your household employed in the quarry company?

(a) Yes (b) No

ii) If yes how many work in the quarry company.....

## **SECTION B: EFFECTS OF QUARRYING**

10. Are you affected by the ongoing quarrying activity?

(a) Yes (b) No

11. If yes what effects does it have on:

### **i) Environment**

a. Water.....

b. Air quality.....

c. Agricultural Lands.....

d. Afforestation.....

e. Noise.....

### **ii) Social**

a. Buildings.....

b. Effects on School enrolment.....

c. Effects on Migration Pattern.....

d. Effects on Health.....

e. Effects on social life style.....

f. Provision of social Amenities.....

### iii) Economics

- a. Employment.....
- b. Income.....
- c. Women's employment.....

## SECTION C: MITIGATION MEASURES

12. i) Are the quarrying companies doing anything about the identified adverse effects?

**(a) Yes (b) No**

ii) If yes what are some of the measures of mitigation

1.....

2.....

3.....

iii) In your own opinion, how effective are the mitigation measures

(a) **Highly effective** (b)

**Moderately effective (c) Ineffective**

iv) Give reason for your answer in (iii) above

.....

13. What will you recommend to be done by the quarrying activities so as to reduce its adverse effects?



**APPENDIX 2**  
**KWAME NKRUMAH UNIVERSITY OF SCIENCE TECHNOLOGY**  
**COLLEGE OF ARCHITECTURE AND PLANNING**  
**DEPARTMENT OF PLANNING**

**QUESTIONNAIRE FOR TRADITIONAL AUTHORITIES**

**Preamble**

This questionnaire seeks to collate information from the relevant institutions to aid the study into “*Assessing the Effects of Stone Quarrying in Wenchi Municipality*”. The information would be used for postgraduate thesis that would be submitted for a partial fulfillment of **Master of Science Development Policy and Planning in KNUST**.

*Data collected is highly confidential:*

**SECTION A: BACKGROUND OF INSTITUTION**

1) Name of community? .....

2) What role do you play concerning this community’s development?

.....  
.....  
.....

3) Are you aware of the quarrying activities in your traditional area?

a. Yes [ ]      b. No [ ]

**SECTION B: OPERATIONS OF THE QUARRYING FIRMS**

4) Do the operators in any way carry out an **Environmental Impact Assessment** before commencement of the operation?

a. Yes [ ]      b. No [ ]

5. How are quarrying activities carried out in your traditional area?

.....  
.....  
.....  
5. i) Is the method identified above sustainable?

a) Yes                      b) No

5.ii) If **No** why? .....

6). Do they pay royalties to you?

**a. Yes** [   ]      **b. No** [   ]

7) If yes, how much do they pay per day / month / year? .....

7i) What do you use the royalties for?  
.....

### **SECTION C: EFFECTS OF STONE QUARRYING**

8) Are you aware of any children and women involved in this activity?

**a. Yes** [   ]                      **b. No** [   ]

9) If yes, is it having any negative impact on school enrolment?  
.....

10) What is being done to discourage children from getting involved in this activity?  
.....  
.....

11) Are there benefits people derive from the quarrying activity?

**a. Yes** [   ]      **b. No** [   ]

12) If yes, enlist some of the benefits  
.....  
.....

13) Do you see any damage being caused by the quarrying activity?

**a. Yes** [   ]      **b. No** [   ]

- 14) If yes, in what form?
- a. environmental      [   ]
  - b. social                [   ]
  - c. economic            [   ]

**Environmental**

- i. Air.....
- ii. Water.....
- iii. Land.....

**Social**

- i. Houses.....
- ii. Education.....
- iii. Health.....

**Economic**

.....

.....

.....

**SECTION D: MITIGATION MEASURES**

15) What measures are currently available to solve these problems?

.....

.....

.....

16). Do you think this activity should be banned completely?

**a. Yes [   ]   b. No [   ]**

17) If yes, why?.....

18) If no, why?.....

19) What measures are there to check its sustainability?.....

20) What future problems do you think this activity can cause? List them.

.....

.....

.....

21) How do you monitor the socio-economic problems in the community as a result of the stone quarrying?

.....

**SECTION E: COLLABORATION WITH OTHER INSTITUTIONS**

22) Do you collaborate with the Assembly or any Civil Society Organization in making decisions on the quarry firms around?

**a. Yes [    ]    b. No [    ]**

23) If yes how do you collaborate?

.....  
.....  
.....

24) If no why is there no collaboration

.....  
.....  
.....

**APPENDIX 3**  
**KWAME NKRUMAH UNIVERSITY OF SCIENCE TECHNOLOGY**  
**COLLEGE OF ARCHITECTURE AND PLANNING**  
**DEPARTMENT OF PLANNING**

**Preamble**

This questionnaire seeks to collate information from the key informants to aid the study into “*Assessing the Effects of Stone Quarrying on Wenchi Municipality*”. The information would be used for postgraduate thesis that would be submitted for a partial fulfillment of **Master of Science Development Policy and Planning in KNUST**.

**QUESTIONNAIRE FOR KEY INFORMANTS**

1. Name of community .....
2. What position do you occupy in the community? .....
3. Are you aware of the quarrying operations in the community? **a) Yes**      **b) No**
4. Can you briefly explain the operation methods of the quarrying companies around?  
.....  
.....  
.....
5. Is the identified method sustainable? **a) Yes**      **b) No**
6. If **No** why?.....

**EFFECTS OF QUARRYING**

7. Are children of school going age working at the quarry? **a) Yes**      **b) No**
8. If **Yes**, how is it affecting school enrolment?  
.....  
.....
9. What is being done to discourage children from getting involved in this activity?  
.....  
.....  
.....

10. Are the community members benefiting from the quarrying activity?

**a) Yes**

**b) No**

11. If yes, how are you benefiting from it?

.....

.....

.....

12. Do you see any damage being caused by the quarrying activity?

**a) Yes**

**b) No**

13. If yes, what are the effects of the quarrying activity on the;

- Water bodies .....
  - Air quality .....
  - Agricultural lands .....
  - Environmental serenity .....
  - Health .....
  - Local Economic Development .....
- .....
- .....

### **MITIGATION MEASURES**

14. Are there mitigation measures to combat the identified effects of the quarrying activity?

**a) Yes**

**b) No**

15. If yes can you list some of the mitigation measures in place

.....

.....

.....

16. Is/are the identified mitigation measures effective? **a) Yes** **b) No**

17. What will you recommend to be done about stone quarrying in the locality

.....

.....

.....

**APPENDIX 4**

**KWAME NKRUMAH UNIVERSITY OF SCIENCE TECHNOLOGY**

**COLLEGE OF ARCHITECTURE AND PLANNING**

**DEPARTMENT OF PLANNING**

**Preamble**

This questionnaire seeks to collate information from the relevant institutions to aid the study into “*Assessing the Effects of Stone Quarrying in Wenchi Municipality*”. The information would be used for postgraduate thesis that would be submitted for a partial fulfillment of **Master of Science Development Policy and Planning in KNUST**.

**QUESTIONNAIRE FOR WENCHI MUNICIPAL ASSEMBLY.**

**SECTION A: FUNCTION(S) AND KNOWLEDGE OF THE ASSEMBLY ABOUT QUARRYING**

1. What are the roles of the Assembly with respect to environmental protection?

.....

.....

.....

2. Are you aware of the existence of quarrying companies in the Municipality?

**A. YES [ ] B. NO [ ]**

3. If yes, what factors initiated the quarrying activities?

.....

.....

.....

4. For how long has the quarrying operation been in existence in the Municipality?

.....

5. Which category of people are mainly involved in the quarrying operation?

.....

.....

.....

6. Why do people engage in quarrying in spite of other economic activities?

.....

.....

.....

7. What are the main quarrying companies operating in the Municipality?

Quarrying Groups	Location/Town/Village

8. Have these quarrying companies registered with your outfit?

A. YES [ ] B. NO [ ]

9. If yes, what are the companies that have registered with the municipality?

.....

.....

10. If no, why?.....

11. Do these quarrying companies submit an Environmental Impact Assessment before commencing their activities?

A. YES [ ] B. NO [ ]

12. If no, what is being done about it?

.....

.....

13. Do the quarrying companies pay taxes to the Municipal Assembly?

A. YES [ ] B. NO [ ]



14. If yes, how much do they pay monthly/yearly?

.....  
.....

15. If no, why?.....

16. What does the Assembly use the taxes collected from the quarrying companies for?

.....  
.....  
.....

17. What proportion is used for the provision of social amenities?

.....  
.....

#### **SECTION B: METHODS OF OPERATION**

18. Does your outfit have a hand in granting permits/ concessions for the operation of the quarries?

**A. YES [   ] B. NO [   ]**

19. If yes, in what form?

.....  
.....

20. Can you briefly describe the methods of operation of the quarrying companies?

.....  
.....  
.....  
.....

20. i) What action do you take on quarrying companies operating contrary to the ethical standard of operation?

.....  
.....

### **SECTION C: EFFECTS OF STONE QUARRYING**

21. Are you aware of children engagement in quarrying?

**A. YES** [ ] **B. NO** [ ]

22. If yes, how is it affecting school enrolment in the quarrying communities?

.....

23. What are the effects of stone quarrying on the following areas?

#### **Environmental**

i. Air.....

ii. Water.....

iii. Land.....

#### **Social**

iv. Houses.....

v. Education.....

vi. Health.....

#### **Economic**

.....

.....

.....

### **SECTION D: MITIGATION MEASURES**

24. What measures are being put in place by the Municipality to mitigate the negative effects of quarrying in the Municipality?

.....

.....

.....

25. Do you think the activity is sustainable?

**A. YES** [ ] **B. NO** [ ]

26. Give reasons for your answer above?

.....  
.....  
.....  
.....

**SECTION E: COLLABORATION WITH OTHER RELEVANT INSTITUTIONS**

27. Do you collaborate with the **Environmental Protection Agency** and the **Traditional Authority** in any way in taking decisions on the quarrying activities?

**A. YES** [ ☐ ] **B. NO** [ ☐ ]

28. If yes, how do you collaborate with the following institutions?

i) Environmental Protection Agency

.....  
.....  
.....

ii) Traditional Authority

.....  
.....  
.....

iii) Quarrying companies

.....  
.....  
.....

28. Are you aware of illegal quarrying going on in the Municipality?

**A. YES** [ ☐ ] **B. NO** [ ☐ ]

28i) If yes what is been done about the situation?

.....  
.....

## **APPENDIX 5**

### **KWAME NKRUMAH UNIVERSITY OF SCIENCE TECHNOLOGY**

### **COLLEGE OF ARCHITECTURE AND PLANNING**

### **DEPARTMENT OF PLANNING**

## **QUESTIONNAIRE FOR ENVIRONMENTAL PROTECTION AGENCY**

### **Preamble**

This questionnaire seeks to collate information from the *Environmental Protection Agency* to aid the study into “*Assessing the Effects of Stone Quarrying on the Wenchi Municipality*”. The information would be used for postgraduate thesis that would be submitted for a partial fulfillment of **Master of Science Development Policy and Planning in KNUST**.

Information provided would be confidential;

### **SECTION A: BACKGROUND OF THE INSTITUTION**

1. What are the roles of this agency (with respect to stone quarrying operations)?

.....  
.....

2. Are there any quarrying groups in the Wenchi Municipality registered with your agency?

**a. Yes            b. No**

3. If yes, how many? .....

4. If no, why? .....

### **SECTION B: QUARRYING COMPANIES PRESENT**

5. Name the quarrying groups/firms and their spatial locations?

<b>Quarrying groups</b>	<b>Location/town/village</b>

6. Do these quarrying groups submit an *Environmental Impact Assessment* report to your institution before they start work? **a. Yes            b. No**

7. If no, what is being done about it?

.....  
.....  
.....

### **SECTION C: OPERATIONAL METHODS**

8. Can you briefly describe the recommended way (if there is) of quarrying which is more environmentally friendly?

.....  
.....  
.....

9. Are the quarrying companies in the Municipality complying with the above quarrying method?

**(a) Yes            (b) No            (c) Not all**

9.i) What action do you take when you find out that the methods of operations of a quarrying company is contrary to the recommended one?

.....  
.....

### **SECTION D: EFFECTS OF STONE QUARRYING**

10. What effects are the quarrying activities having on the:

#### **Environmental**

1. Air .....
2. Water.....
3. Land.....

**Social**

4. Houses.....
5. Education.....
6. Health.....

**SECTION E: MITIGATION MEASURES**

11. How do you constantly monitor the effects identified above?  
.....  
.....
12. What measures do you put in place to reduce some of the problems caused by quarrying?  
.....  
.....
13. Do you think this activity should be banned completely?  
**a. Yes [ ] b. No [ ]**
14. If yes, why?.....
15. If no, why?.....

**SECTION F: COLLABORATION**

16. Do you collaborate with the Municipal Assembly and the Traditional Authority in taking decisions on the quarrying activities? **a. Yes [ ] b. No [ ]**
17. How do you collaborate with the:
- i) Municipal Assembly  
.....  
.....  
.....
- ii) Traditional Authority  
.....  
.....

***Thank you***